TBS

Planning aids and basic knowledge

Transient and lightning protection systems

Building Connections

OBO BETTERMANN

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OBO BETTERMANN

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OBO Construct planning aids

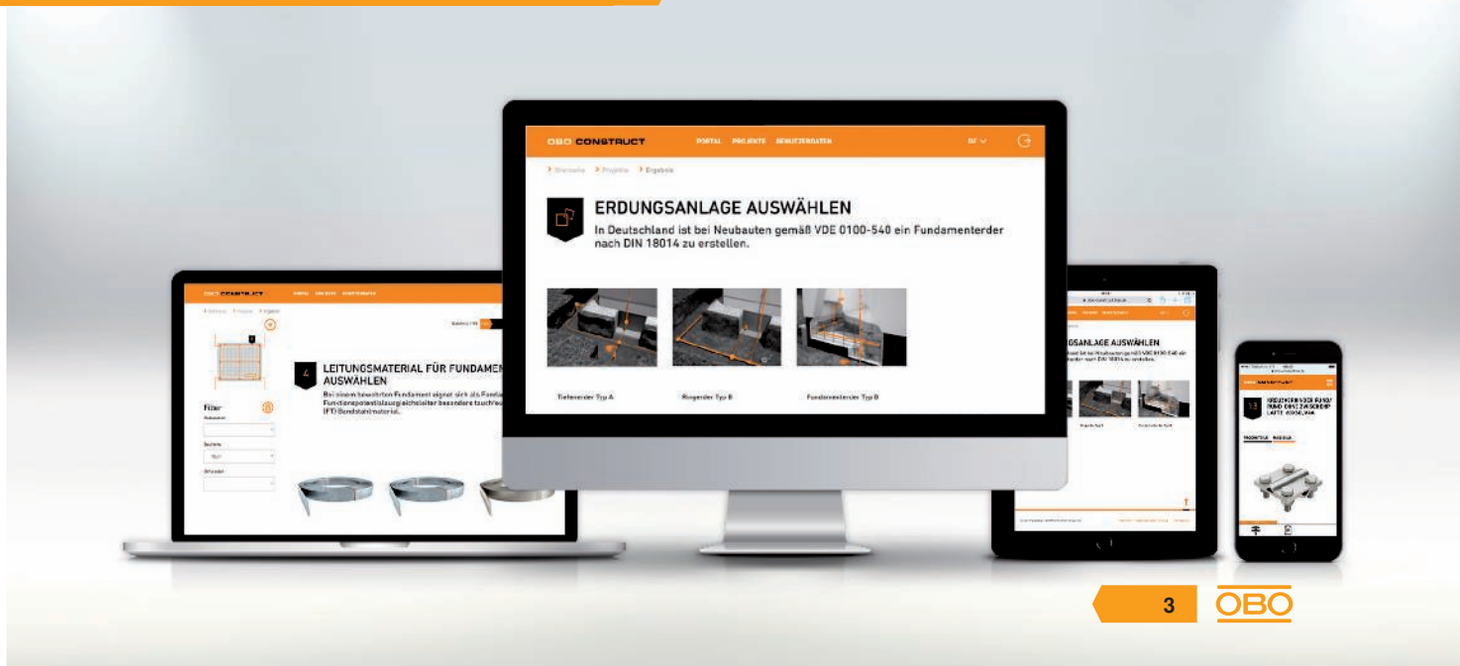
Digital selection aids for earthing systems and surge protection
The OBO Construct electronic planning aids are programs developed to support electrical installation engineers and planners in the design of electrical installation systems. In particular, in complex areas such as surge protection and earthing, there are countless technical and standard general conditions to be observed. The two OBO Construct programs for earthing and surge protection systems should provide active help here. Systematic polls simplify the search for suitable products and guaranteed surge protection systems and earthing systems which fulfil the standards.

OBO Construct for surge protection
This online tool aids you in the project-orientated selection and connection of suitable surge protection systems and provides you with information on the OBO surge protection systems. You can create your personal materials list, connection diagram and invitation to tender texts quickly, efficiently and in a targeted manner for complete surge protection in the fields of energy technology, photovoltaics, telecommunication, MSR, TV, HF and data technology. The result can be exported easily into Excel format for further processing.

OBO Construct for earthing systems
The digital selection aid can be used for the easy planning and configuration of earthing systems. The simple and intuitive user guidance leads you through the individual components of the earthing system step by step. The software then automatically calculates the amounts required and the matching accessories. The application can be opened on any end device irrespective of its operating system – be it smartphone, tablet or desktop PC.

Benefits

- Work aid independent of time and place
- Transmit planning requirements to complete product systems
- Find suitable products quickly and simply
- Calculate material and parts lists automatically
- Download configuration results as Excel or Word files



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Lightning protection guide. Safely routed.

Reference work and planning aid for electrical installation engineers and technical planners
At OBO Bettermann, we can look back on more than 90 years of experience in the field of lightning and surge protection. This experience and, of course, the latest standards and technical innovations have flowed into the company's new lightning protection guide. The brochure allows you to plan installations in the field of lightning and surge protection faster and more easily.

It contains a balanced mixture of both basic and expert knowledge, as well as planning and selection aids for the protection of buildings and systems.

The new lightning protection guide can be requested by calling +49 23 73 89 - 17 00 and is also available at the address below for download:
http://obo.eu/Leitfaden

Topics

- Basic principles
- The external lightning protection system
- Air-termination and down-conductor systems
- Examples and selection aids for wind load calculation conform with Eurocode 1+3
- Earthing systems with foundation earther to current DIN 18014
- The internal lightning protection system
- Equipotential bonding systems
- Overvoltage protection systems
- Current standards
- New selection and planning aids
- Examples

OBO TBS seminars: First-hand knowledge
With a comprehensive programme of training courses and seminars on the subject of surge voltage and lightning protection systems, OBO is able to support its customers with specialist knowledge from a single source. Alongside the basic theoretical principles, the programme also deals with practical implementation in everyday applications. Special calculation and application examples round off the comprehensive programme of knowledge transfer.

Invitations to tender on the Internet at www.ausschreiben.de
More than 10,000 entries from the cable support systems, fire protection systems, connection and fastening systems, transient and lightning protection systems, cable routing systems, device systems and underfloor systems can be recalled for free. Regular updates and extensions mean that you always have a comprehensive overview of the OBO products. All the current file formats (PDF, DOC, GAEB, HTML, TEXT, XML, ÖNORM) are available.
www.ausschreiben.de

Invitations to tender, product information and data sheets
We can make life easier for you, with our comprehensive selection of materials designed for practical applications, which provide you with effective support with the planning and calculation of a project. These include:
- Invitations to tender
- Product information
- Data sheets
- Data sheets

Invitations to tender for lightning protection/earthing at the highest level:
OBO manufacturers products to RAL GZ642-5 and is dedicated to compliance with the RAL directives. Lightning protection and earthing products can be used for invitations to tender according to RAL.

These documents are continually updated and can be downloaded for free at any time from the Internet download area at
www.obo-bettermann.com.

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Customer service and credibility
Friendliness, reliability and competence create acceptance, credibility and lasting working relationships. These shared values arise from OBO's consistent orientation around the wishes and needs of its customers. Close partnerships with customers is OBO's foremost priority.

Help and advice
Answers to questions about products and installation, planning advice for complex projects – OBO's staff will help you through every phase of your project, no matter what field it is in. We are constantly improving the support we provide in every phase of collaboration, laying the foundations for genuine partnerships.

Speed and reliability
Optimised procedures and highly developed logistics ensure that OBO products are in the right place at the right time, anywhere in the world. OBO offers comprehensive support for large-scale projects, from planning all the way to installation.

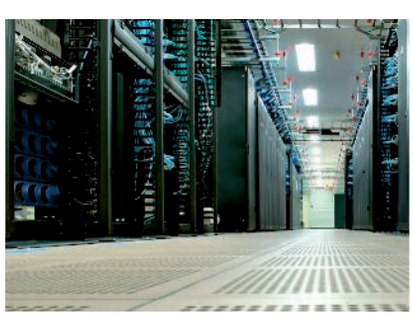
Lightning protection guide
Free order
and download from
www.obo.de

- Production location
- Subsidiary
- Representative

Minor cause, major effect: Damage caused by surge voltages

Our dependency on electrical and electronic equipment continues to increase, in both our professional or private lives. Data networks in companies or emergency facilities such as hospitals and fire stations are lifelines for an essential real time information exchange. Sensitive databases, e.g. in banks or media publishers, need reliable transmission paths.

It is not only lightning strikes that pose a latent threat to these systems. More and more frequently, today's electronic aids are damaged by surge voltages caused by remote lightning discharges or switching operations in large electrical systems. During thunderstorms too, high volumes of energy are instantaneously released. These voltage peaks can penetrate a building though all manner of conductive connections and cause enormous damage.



Financial implications of lightning and surge voltage damage

Financial loss can only be considered in isolation in cases where no legal or insurance requirements relating to personal safety apply.

Substantial losses result from the destruction of electrical devices, notably:

- Computers and servers
- Telephone systems
- Fire alarm systems
- Monitoring systems
- Lift, garage door and roller shutter drives
- Consumer electronics
- Kitchen appliances

Further costs can also be incurred due to outages and consequential damage in relation to:

- Loss of data
- Production outage
- Loss of contactability (Internet, telephone, fax)
- Defective heating systems
- Costs due to faults and false alarms in fire and burglar alarm systems

Financial losses are on the rise

Current statistics and estimates of insurance companies show: Damage levels caused by surges – excluding consequential or outage costs – long since reached drastic levels due to the growing dependency on electronic "aids". It's no surprise, then, that property insurers are checking more and more claims and stipulating the use of devices to protect against surges. Information on protection measures can be found in e.g. the German Directive VDS 2010.

Year	Number of lightning and surge voltage damage cases	Paid damages for lightning and surge voltage damage
1999	490,000	€310 million
2006	550,000	€340 million
2007	520,000	€330 million
2008	480,000	€350 million
2009	490,000	€340 million
2010	330,000	€220 million
2011	440,000	€330 million
2012	410,000	€330 million
2013	340,000	€240 million
2014	410,000	€340 million
2015	350,000	€240 million
2016	300,000	€210 million

Number of instances of damage from lightning and surge voltages and amounts paid out by home and contents insurance companies; source: GDV · Extrapolation based on industry and risk statistics; numbers rounded to the nearest 10,000 or €10 million.

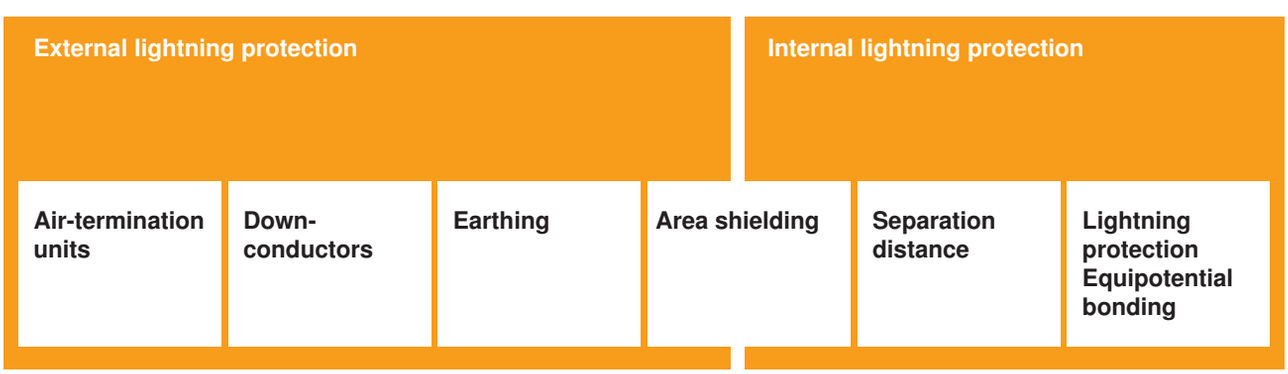
Lightning and surge protection standards

When planning and executing a lightning protection system, it is necessary to observe all relevant national annexes and take account of any special circumstances or applications and the safety stipulations in the relevant country-specific supplements.
A lightning and surge protection system consists of several systems, each tailored to each of the others. At its most basic, a lightning and surge protection system consists of one internal and one external lightning protection system.

These, in turn, can be categorised as follows:
- Air-termination devices
- Down-conductors
- Earthing systems
- Area shielding
- Separation distance
- Lightning protection equipotential bonding system

These systems must be carefully selected for the application at hand, and used in a coordinated way. Installation of the systems takes place according to various application and product standards. The supplements to the international IEC guidelines and harmonised European versions of the various country-specific translations often contain additional informative information specific to the country in question.

Product standards
To ensure that the components can withstand the loads to which they are likely to be exposed in application, they must be checked against the respective product standard for external and internal lightning protection.



External and internal lightning protection systems

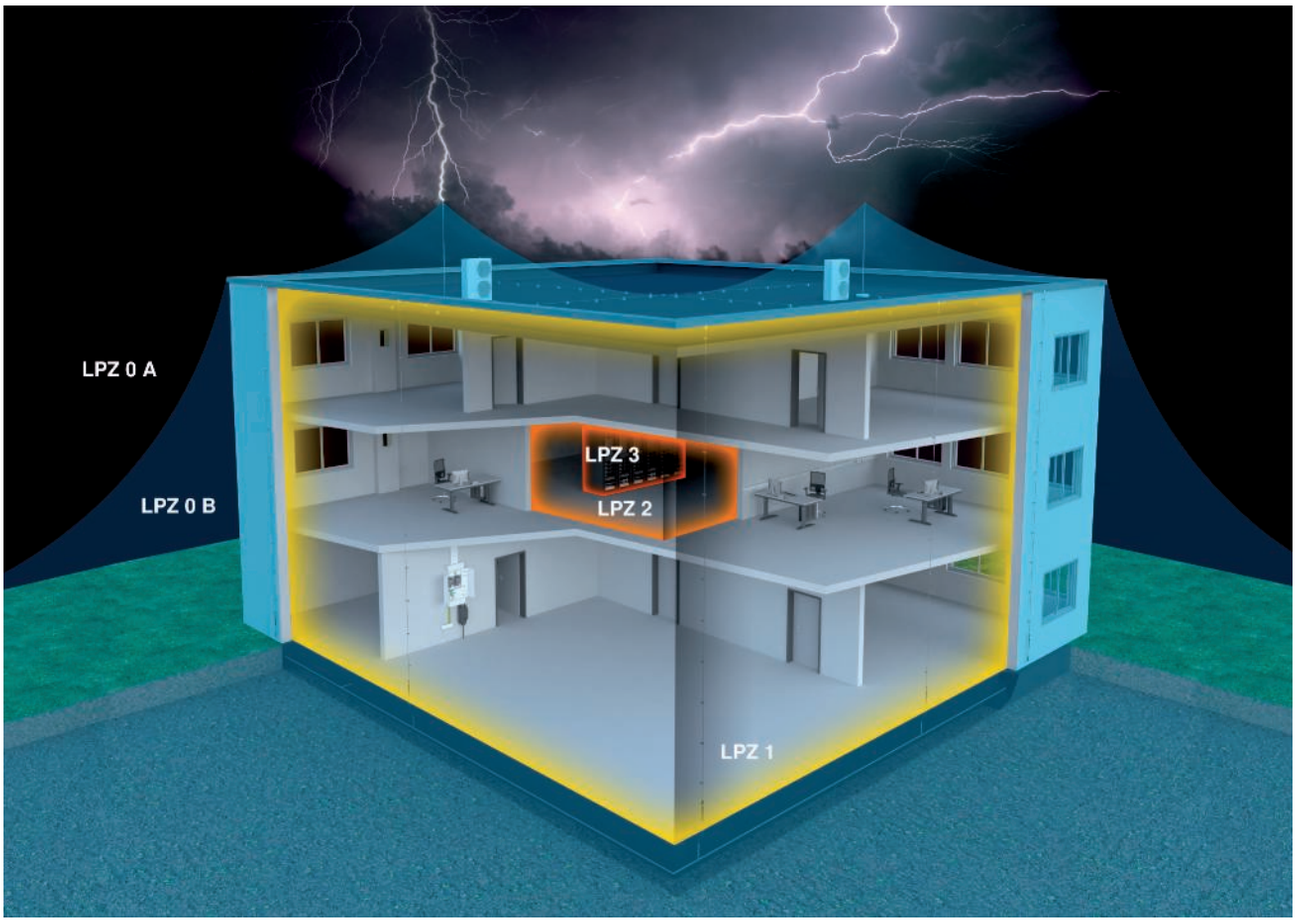
Standard	German supplement	Contents
VDE 0185-305-1 (IEC 62305-1)		Protection against lightning – Part 1: General principles
VDE 0185-305-2 (IEC 62305-2)		Protection against lightning – Part 2: Risk management
	1	Lightning risk in Germany
	2	Calculation aids for estimating the risk of damage for buildings
	3	Additional information on use of EN 62305-2
VDE 0185-305-3 (IEC 62305-3)		Protection against lightning – Part 3: Protection of structures and people
	1	Additional information on use of EN 62305-3
	2	Additional information for building structures
	3	Additional information for the testing and servicing of lightning protection systems
	4	Use of metal roofs in lightning protection systems
	5	Lightning and surge protection in PV power supply systems
VDE 0185-305-4 (IEC 62305-4)		Protection against lightning – Part 4: Electrical and electronic systems within structures
	1	Distribution of the lightning current
VDE 0675-6-11 (IEC 0675-6-11)		Low-voltage surge protection devices – Part 11: Surge protection devices connected to low-voltage power systems
VDE 0100-534 (IEC 60364-5-53)		Low-voltage electrical installations - Part 5-53: Selection and erection of electrical equipment – Isolation, switching and control – Clause 534: Devices for protection against surge voltages
VDE 0100-443 (IEC 60364-4-44)		Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances – Clause 443: Protection against surge voltages of atmospheric origin or due to switching
VDE 0100-712 (IEC 60364-7-712)		Requirements for operational premises, special rooms and systems – Solar photovoltaic (PV) power supply systems

Key lightning protection standards and specifications

Product standards	Contents
VDE 0185-561-1 (IEC 62561-1)	Lightning protection system components – Requirements for connection components
VDE 0185-561-2 (IEC 62561-2)	Lightning protection system components – Requirements for conductors and earthers
VDE 0185-561-3 (IEC 62561-3)	Lightning protection system components – Requirements for spark gaps
VDE 0185-561-4 (IEC 62561-4)	Lightning protection system components – Requirements for holders
VDE 0185-561-5 (IEC 62561-5)	Lightning protection system components – Requirements for inspection boxes and earther penetrations
VDE 0185-561-6 (IEC 62561-6)	Lightning protection system components – Requirements for lightning strike counters
VDE 0185-561-7 (IEC 62561-7)	Lightning protection system components – Requirements for earthing enhancing compounds
IEC TS 62561-8	Lightning protection system components – Requirements for components for insulated lightning protection systems
VDE 0675-6-11 (IEC 61643-11)	Surge protection devices for use in low-voltage power systems – Requirements and test methods
VDE 0845-3-1 (IEC 61643-21)	Surge protection for use in telecommunications and signalling networks

Lightning protection and surge protection components

Gradual surge reduction with lightning protection zones



Lightning protection zone concept
The lightning protection zone concept described in international standard IEC 62305-4 (DIN VDE 0185 Part 4) has proved to be practical and efficient. This concept is based on the principle of gradually reducing surges to a safe level before they reach the terminal device and cause damage. In order to achieve this situation, a building's entire energy network is split into lightning protection zones (LPZ = Lightning Protection Zone). Installed at each transition from one zone to another is a surge arrestor for equipotential bonding. These arrestors correspond to the requirement class in question.

Lightning protection zone

LPZ 0 A		Unprotected zone outside the building. Direct lightning strike, no shielding against electromagnetic interference pulses LEMP (Lightning Electromagnetic Pulse).
LPZ 0 B		Through the area protected by the external lightning protection system. No shielding against LEMP.
LPZ 1		Zone inside the building. Low partial lightning energies possible.
LPZ 2		Zone inside the building. Low surges possible.
LPZ 3		Zone inside the building (can also be the metal housing of a consumer). No interference pulses through LEMP or surges present.

Choosing the right surge protection devices

The classification of surge protection devices into types means they can be matched to different requirements with regard to location, protection level and current-carrying capacity. The table provides an overview of the zone transitions. It also shows which OBO surge protection devices can be installed in the energy supply network and their respective function.

Zone transition	Protection device and device type	Product example	Product figure
LPZ 0 B to LPZ 1	Protection device for lightning protection equipotential bonding in accordance with VDE 0185-305 (IEC 62305) for direct or close lightning strikes. Devices: Type 1+2 (Class I+II), e.g. CCF Compact Max. protection level according to standard: 1.5 kV OBO protection level: < 1.5 kV Installation e.g. in the main distributor/at building entry	MCF Compact Item no.: 5096987	
LPZ 1 to LPZ 2	Protection device for lightning protection equipotential bonding in accordance with VDE 0185-305 (IEC 62305) for direct or close lightning strikes. Devices: Type 2 (Class II), e.g. V20 Max. protection level according to standard: 1.5 kV OBO protection level: < 1.3 kV Installation e.g. in the main distributor/at building entry	V20 Item no.: 5095253	
LPZ 2 to LPZ 3	Protection device, designed for surge protection of portable consumers at sockets and power supplies. Devices: Type 3 (Class III), e.g. ÜSM-A Max. protection level according to standard: 1.5 kV OBO protection level: < 1.3 kV Installation e.g. on the end consumer	ÜSM-A Item no.: 5092451	

BET – testing centre for lightning protection, electrical engineering and support systems

Lightning current generator

BET with countless tasks
Whereas previously only lightning current, environmental and electrical testing had been possible at BET, the BET Test Centre is now also a competent partner for the testing of cable support systems. This combination has made it necessary to revise the meaning of the name. If BET previously stood for "Blitzschutz- und EMV-Technologiezentrum" (Lightning protection and EMC technology centre), since 2009 these letters have meant BET Test Centre for lightning protection, electrical engineering and support systems.

Test generator for lightning current tests
The test generator planned in 1994 and completed in 1996 makes it possible to carry out lightning current tests at up to 200 kA. The generator was planned and constructed in cooperation with Soest Technical College. Due to the intensive planning and scientific support in the construction of the test system, it has worked for 20 years without errors and meets current standardised test requirements.

Testing tasks
The main load of the testing generator is generated through the testing of products from the TBS product division. For this, developmental tests of new developments, modifications to existing OBO products and also comparison tests with competitive products are carried out. These include lightning protection components, surge protection devices and lightning arrestors. Tests for lightning protection components are carried out according to DIN EN 62561-1, for spark gaps according to DIN EN 62561-3 and for lightning and surge protection devices according to DIN EN 61643-11. This is only a small amount of the testing standards used for tests in the BET Test Centre.

Certification

In development, manufacture and marketing, the products of OBO Bettermann are subject to high, standardised quality standards and international standards. For decades now, OBO Bettermann has operated ISO 9001-certified quality management, which also fulfils the high requirements of the ATEX 2014/34/EU directive for EX products. In addition, OBO has run certified energy management according to ISO 50001 and is a long-standing member of Industrieverband Feuerverzinken e.V.

The BET Test Centre is a testing laboratory, recognised and certified by VDE, for the execution of countless international standards for lighting protection systems.

Zertifikat zur Anerkennung
Certificate of acceptance

von / of

OBO Bettermann GmbH & Co. KG
BET Testcenter
Hüingser Ring 52
58710 Menden
GERMANY

durch die / by the

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute

für das / for the

Acceptance Program

Stufe 2 / in Stage 2

40046136

2019-06-22

5022908-9501-0001/237781

VDE INSTITUT

Zertifikat
Mitteilung über die Bewertung des Qualitätssicherungssystems

2 Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen
Richtlinie 2014/34/EU
Anhang IV - Modul D: Konformität mit dem Baumuster auf der Grundlage einer Qualitätssicherung bezogen auf den Produktionsprozess
Anhang VII - Modul E: Konformität mit dem Baumuster auf der Grundlage der Qualitätssicherung bezogen auf das Produkt

3 Nummer des Zertifikates: BVS 16 ATEX ZQS/E310

4 Produktkategorie: Geräte und Komponenten
Gerätegruppe II, Kategorien 1G, 2G: Transienten- und Blitzschutz-Systeme

DEKRA

WERTE BEWAHREN FEUERVERZINKEN

Industrieverband Feuerverzinken e.V.
Mörsenbroicher Weg 200
40470 Düsseldorf

Tel.: 0211 690765-0
Fax: 0211 690765-28
info@feuerverzinken.com
www.feuerverzinken.com

Confirmation

Herewith we confirm, that

OBO BETTERMANN GmbH & Co. KG
Hüingser Ring 52
58710 Menden

is a member of our association

Industrieverband Feuerverzinken e. V., Düsseldorf.

The company OBO BETTERMANN GmbH & Co. KG provides among other things corrosion protection for fabricated iron and steel articles by hot dip galvanizing and examines that business in accordance with the requirements of the standard

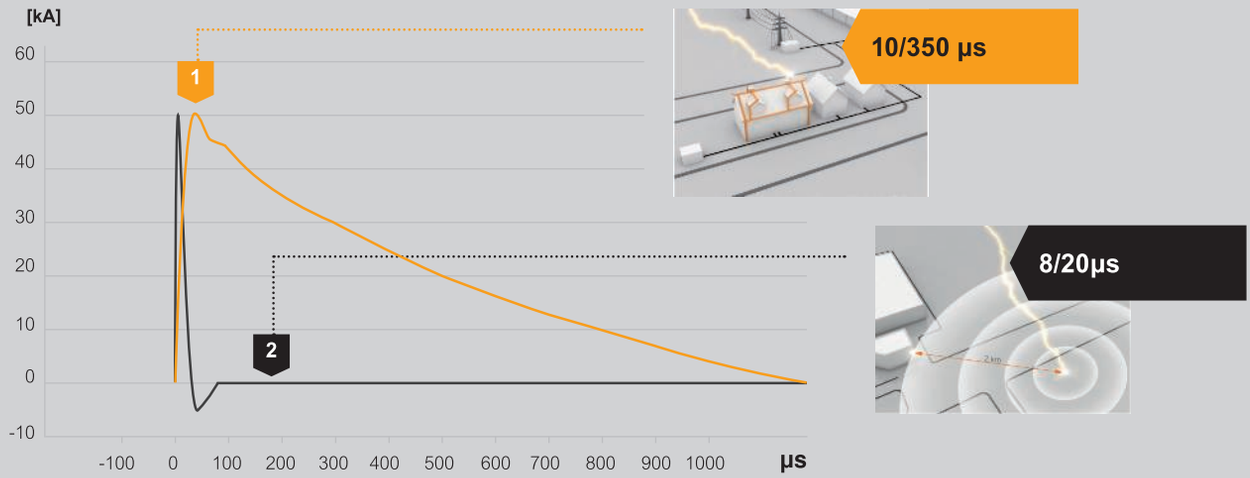
DIN EN ISO 1461
"Hot dip galvanized coatings on fabricated iron and steel articles – specifications and test methods".

Industrieverband Feuerverzinken e.V.
- Director -

Düsseldorf, February 3rd, 2017

Mark Huckshold

Fachzertifizierer



1	Pulse shape 1: Direct lightning strike, 10/350 µs simulated lightning pulse
2	Pulse shape 2: Remote lightning strike or switching operation, 8/20 µs simulated current pulse (surge voltage)

Types of pulse and their characteristics

Testing types for lightning and surge protection

Both lightning current tests and surge voltage tests can be carried out at up to 20 kV. A hybrid generator is used for these tests, which was also developed as part of a cooperation with the Soest Technical College. EMC testing of cable support systems can also be carried out using this test generator. All kinds of cable routing and cable support systems of up to 8 m length can be tested without any difficulties. Tests for electrical conductivity according to IEC 61537 are also carried out.

Simulation of real environmental conditions

To carry out standardised tests on components intended for external use, they must be pretreated under real environmental conditions. This takes place in a salt spray trough and a sulphur dioxide testing chamber. Depending on the test, the test length and the concentration of the salt spray or sulphur dioxide in the testing chambers may vary. This means that it is possible to conduct tests according to IEC 60068-2-52, ISO 7253, ISO 9227 and EN ISO 6988.

Testing cable support systems

The well-known KTS testing system, newly installed in the BET Test Centre, allows the investigation of the load capacities of any cable support system manufactured by OBO. The basis for this is IEC 61537 and VDE 0639.

In the BET Test Centre, OBO Bettermann has a testing department in which products can be tested according to standards, even during the development phase.

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MCF100-3+NPE+FS
Compact
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L1
L2
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L3

Selection aid, energy technology 20

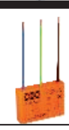
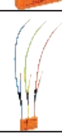
Selection aid, energy technology
AC combination arrester and surge protection; type 1, type 1+2, type 2 and type 3

		Installation location 1 Installation in the main distributor box / combined distributor Basic protection / type 1, type 2				
Initial situation	Building type	Description	Type	Item no.	Test mark	Product figure
l No external lightning protection system l Earthing cable connection 	Private building	TN-/TT Type 2 + 3 2.5 Division Secondary counter zone	V10 Compact	**5093 38 0**		
		TN-/TT Type 2 + 3 4 Division Secondary counter zone	V10-C 3+NPE	**5093 39 1**		
	Multiple dwelling/ industry, commerce	TN-/TT Type 2 4 Division Secondary counter zone	V20 3+NPE	**5095 25 3**	VDE ÖVE UL	
			V20 3+NPE+FS with remote signalling	**5095 33 3**	VDE ÖVE UL	
l External lightning protection system (according to IEC 62305) 	Buildings of lightning protection classes III and IV (e.g. housing, offices and commercial buildings)	TN-/TT Type 1 + 2 4 Division Secondary counter zone	V50 3+NPE	**5093 52 6**	VDE ÖVE UL	
			V50 3+NPE+FS with remote signalling	**5093 53 3**	VDE ÖVE UL	
l Outdoor connection 	Buildings of lightning protection classes I to IV (e.g. industry)	TN-C Type 1 6 Division Pre-metered or secondary counter zone	MCD 50-B 3	**5096 87 7**		
		TN-S Type 1 8 Division Pre-metered or secondary counter zone	MCD 50-B 3+1	**5096 87 9**		

Installation location 2
Installation in the sub-distributor
Medium protection / type 2
Only required if distance ≥ 10m

Description	Type	Item no.	Test mark	Product figure
TN/TT Type 2 + 3 2.5 Division	V10 Compact	**5093380**		
	V10 Compact FS, with remote signalling	**5093382**		
TN/TT Type 2 4 Division	V20 3+NPE	**5095253**	VDE ÖVE UL	
	V20 3+NPE+FS with remote signalling	**5095333**	VDE ÖVE UL	
TN/TT Type 2 4 Division	V20 3+NPE	**5095253**	VDE ÖVE UL	
	V20 3+NPE+FS with remote signalling	**5095333**	VDE ÖVE UL	
TN/TT Type 2 4 Division	V20 3+NPE	**5095253**	VDE ÖVE UL	
	V20 3+NPE+FS with remote signalling	**5095333**	VDE ÖVE UL	

Installation location 2
Installation before the terminal
Fine protection / type 3

Description	Type	Item no.	Product figure	Product figure
Plug-in	FC-D	**5092 80 0**		
	FC-TV-D	**5092 80 8**		
	FS-SAT-D	**5092 81 6**		
	FC-TAE-D	**5092 82 4**		
	FC-ISDN-D	**5092 81 2**		
	FC-RJ-D	**5092 82 8**		
	CNS-3-D-D	**5092 70 1**		
Fixed installation	ÜSM-A	**5092 45 1**		
	ÜSM-A ST-230 1P+PE	**5092 44 1**		
	ÜSS 45-o-RW	**6117 47 3**		
Series installation in distributor	V10 Compact L1/L2/L3/N	**5093 38 0**		
	VF230-AC/DC	**5097 65 0**		
	VF230-AC-FS with remote signalling	**5097 85 8**		


STOP!
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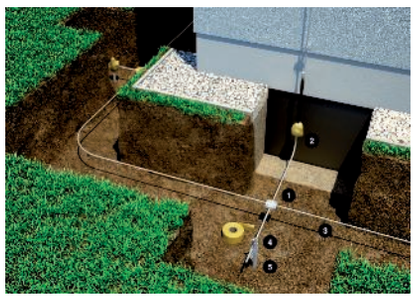
Coordinated protection. The ProtectPlus system kit.

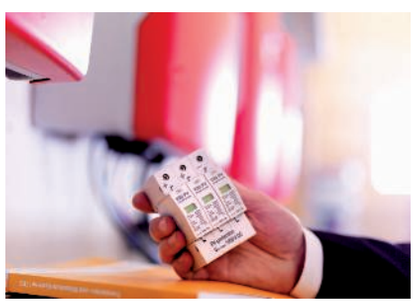
A well-thought-out system for the whole electrical infrastructure of a photovoltaic system – that's ProtectPlus. Different components provide comprehensive protection, which allows both the erection engineer and the system operator to sleep in peace.

External lightning protection systems
Lightning currents are intercepted and run safely to the earth with the following systems:
- Air-termination rods and masts
- Insulated lightning protection
- Insulated isCon® conductor
- Flat and round conductors
- Cable brackets
- Connection clamps and connection terminals



Earthing systems
Our products for perfect earthing:
- Flat and round conductors
- Connectors
- Connection terminals
- Earth entries
- Deep, ring and foundation earthers
- Corrosion protection

Equipotential bonding systems
Equipotential bonding systems are the link between external lightning protection, surge protection and earthing. They are available in the following variants:
- For indoor use
- For outdoor use
- For industrial use



Overvoltage protection systems
A product range for any application:
- Lightning arrestor/combination arrestor
- Surge protection for energy and data technology
- Complete system solutions, terminated and premounted in the housing
- Combination and surge arrestor for photovoltaics, DC side

Cable support systems
Quick-mounting, safe cable routing with:
- Cable trays
- Mesh cable trays
- Cable ladders
- Vertical ladders
- Suspended supports
- Wall and support brackets

Cable routing systems
Tidy cable routing within the building can be achieved using
- Wall and ceiling ducts
- Cable and pipe fastening systems made of plastic and metal
- Screw-in and knock-in systems
- Rail systems

Fire protection systems
Our fire protection system consists of the following components:
- Insulation
- Weatherproof fire protection bandages
- Systems for emergency and escape routes

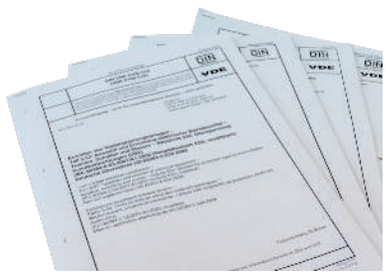
Four steps to comprehensive protection

Step 1:
Check the separation distance
If the required separation distance cannot be complied with, then the metallic parts must be interconnected to be able to carry lightning current.

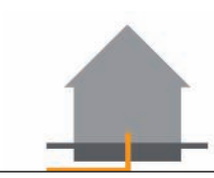
Step 2:
Check the protection measures
Example: measures for lightning protection equipotential bonding are used on the DC and AC side, e.g. lightning arrestor (type 1).

Step 3:
Include data cables
Data cables must be included in the protection concept.

Step 4:
Carrying out the equipotential bonding
Local equipotential bonding must be provided on the inverter.



Overview of protection measures

Initial situation	Measure	Separation distance according to IEC 62305 maintained	Equipotential bonding	Surge protection	Sample product picture
I External lightning protection system (according to IEC 62305) 	Adapt the lightning protection system according to IEC 62305	Yes	min. 6 mm²	DC: Type 2	
				AC: Type 1	
		No	min. 16 mm²	DC: Type 1	
				AC: Type 1	
I No outside lightning protection system I Earthing cable connection 	Requirements' testing: LBO, Vds 2010, risk analysis, ...	-	min. 6 mm²	DC: Type 2	
				AC: Type 2	

Selection aid
Photovoltaic system solutions

Energy technology, type 2, protection of the DC side								
Initial situation	Max. DC voltage	Max. number of MPP per inverter	Max. number of strings per MPP terminal	Connection (DC side)	Version	Type	Item no.	Product figure
l No external lightning protection system l Earthing cable connection The following are required: l Surge voltage protection, type 2 l Lightning protection equipotential bonding 6.5 mm² 	600 V	1	1In/1Out	MC 4 connector		VG-C DCPH-Y1000	**5088 67 0**	
	1000 V	1	1In/1Out	MC 4 connector		VG-C DCPH-Y1000	**5088 67 2**	
		1	2	Terminals	Circuit breaker	VG-C DC-TS1000	**5088 66 0**	
		1	4	Terminals	4 fuse holders, unequipped	VG-C PV1000KS4	**5088 65 4**	
		1	8	Terminals		VG-C DCPH1000-4K	**5088 65 0**	
		1	1 0	Terminals		VG-C DCPH-MS1000	**5088 69 1**	
		2	4	Terminals		VG-CPV1000K 22	**5088 56 8**	
		2	6	Terminals		VG-CPV 1000K 330	**5088 58 2**	
		3	6	Terminals		VG-CPV 1000K 333	**5088 58 5**	
		2	6	Terminals		VG-CPV 1000K 330	**5088 58 2**	
		3	2In/1Out	MC 4 connector		VG-C DCPH1000-31	**5088 64 8**	
		3	6	Terminals		VG-CPV 1000K 333	**5088 58 5**	

You can find the selection aid for AC combination arrestors and surge protection in the chapter Surge Protection in Energy Technology.

Energy technology, type 1+2, protection of the DC side

Initial situation	Max. DC voltage	Max. number of MPP per inverter	Max. number of strings per MPP terminal	Connection (DC side)	Version	Type	Item no.	Product figure
l External lightning protection system according to DIN EN 0185-305 The following are required: l Lightning and surge protection Type 1+2 l Lightning protection equipotential bonding 16 mm² l Separating distance could not be maintained 	600 V	1	1 0	Terminal		VG-BC DCPH-MS600	**5088 69 3**	
	900 V	1	1In/1Out	MC 4 connector		VG-BC DCPH-Y900	**5088 67 8**	
		1	2	Terminals	Circuit breaker	VG-BC DC-TS900	**5088 63 5**	
		1	8	Terminals		VG-BC DCPH900-4K	**5088 63 2**	
		1	1 0	Terminals		VG-BC DCPH-MS900	**5088 69 2**	
		2	4	Terminals		VG-BCPV900K 22	**5088 56 6**	
		2	6	Terminals		VG-BCPV 900K 330	**5088 57 6**	
		3	2In/1Out	MC 4 connector		VG-BC DCPH900-31	**5088 62 9**	
		3	6	Terminals		VG-BCPV 900K 333	**5088 57 9**	
		3	2In/1Out	MC 4 con-		VG-BC DCPH900-31	**5088 62 9**	

Data technology

Initial situation		RJ 45	Terminal	Type	Item no.	Product figure
	l No external lightning protection system l Earthing cable connection	l		ND-CAT6A/EA	**5081 80 0**	
	l External lightning protection system (according to DIN EN 62305)		l	FRD 24 HF	**5098 57 5**	

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Protection and spark gaps/ATEX approval

Task
OBO isolating and protective spark gaps are designed to isolate electrical system components, which under normal operating conditions are not connected together. If lightning strikes cause a potential increase in one of the electrical system components, the isolating spark gap guarantees a conductive connection and therefore equipotential bonding.

Function
As their name suggests, isolating and protective spark gaps comprise a spark gap. This gap transfers from the insulating to the current-permeable condition when an electric arc is ignited by a surge voltage. An isolating spark gap differs from a protective spark gap in its purpose for use. Isolating spark gaps isolate varying earth potentials, while the protective spark gaps are used only in roof standard open-wire lines.

Applications
- For producing an indirect connection between insulating flanges (cathodic corrosion protection).
- For bridging insulating flanges, also in ex-protected areas (tested in accordance with ATEX Directive 94/9/EC).
- Avoidance of drag in residual voltages, especially TT systems.
- For lightning protection equipotential bonding according to DIN VDE 0185-305 (IEC 62305).
- For connecting different earthing systems, the aim being to make optimum use of all earthers for lightning protection equipotential bonding.
- As a measure that saves isolating connections for measuring and test purposes.

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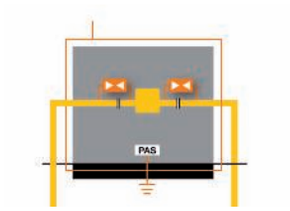
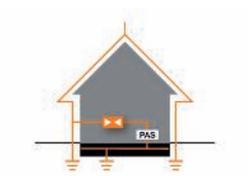
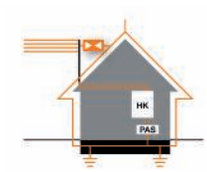
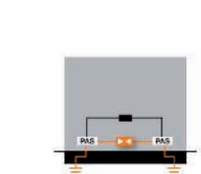
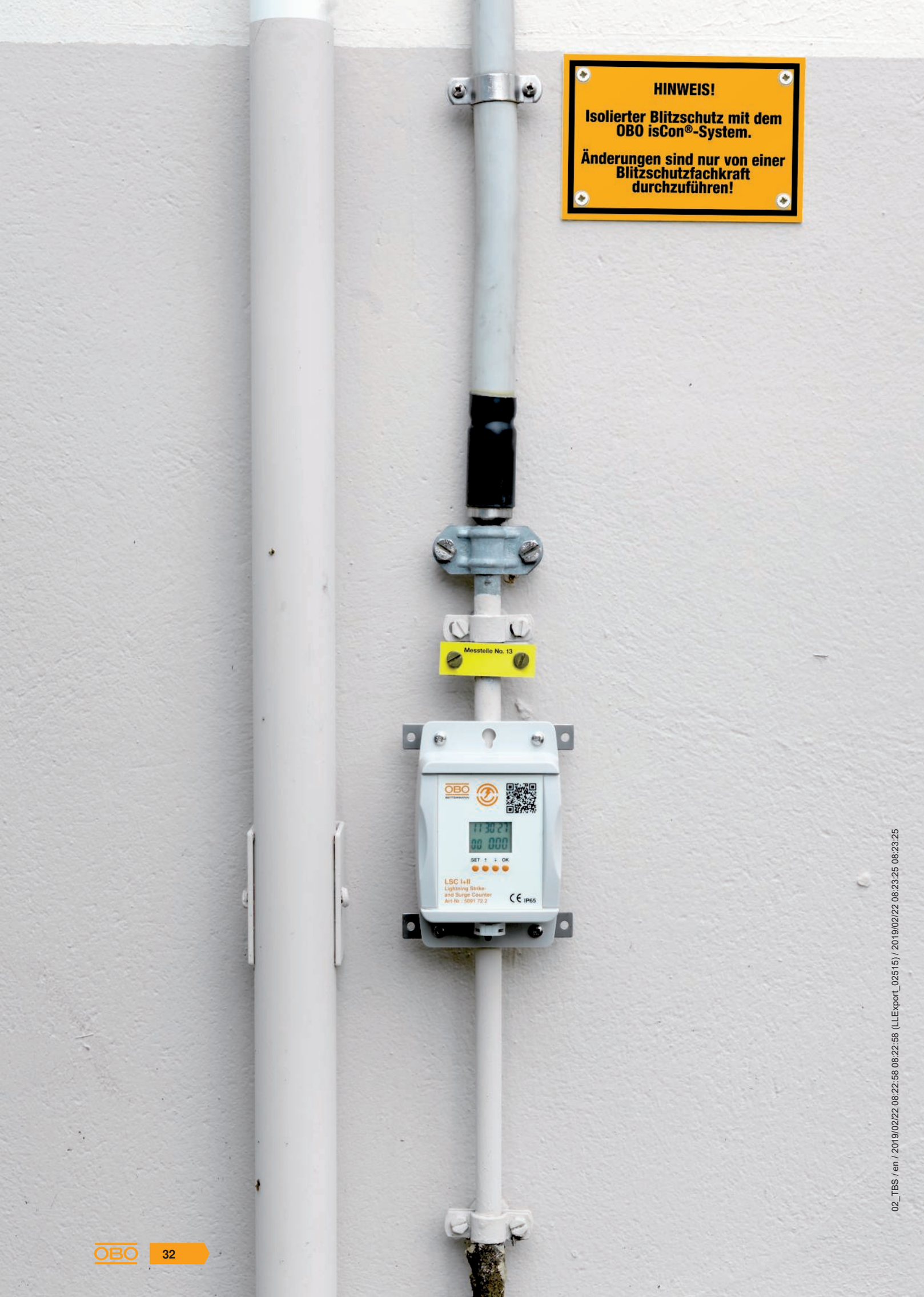
Installation principle for protection and spark gaps

Overview				
Application	Description	Type	Item no.	Product figure
Isolating spark gaps for insulating flange 	l e.g. in a gas pressure control station l Particularly for Ex areas l For bridging of insulating flanges or insulating threaded joints which can carry lightning currents	Type 480	**5240034** **5240077** **5240069** Page: 442	
Isolating spark gaps for potential isolation 	l Several earthing systems in one building, e.g. foundation earther and deep earther l Connection via spark gap l N electrochemical corrosion l Entire earther surface is effective in the event of a direct lightning strike	Type 481	**5240085** Page: 443	
Open-wire connection 	l Roof stand spark gap for insulation l Largest possible distance between the roof stand of a low voltage free cable and a lightning protection system l Distance < 0.5 m: encapsulated spark gap in agreement with the power supply company	Type 482	**5240050** Page: 443	
Coupling of earthing systems 	l Several earthing systems on one building l If the operation of special electronic equipment requires a separate earthing system, then this functional earth must be connected to the operating earth l Prevention of dangerously high voltage differences l An additional throttle is fitted to keep high-frequency voltages away from the functional earthing	Type FS-V20	**5099803** Page: 443	



Measuring and testing systems 34

Life Control testing unit

ISOLAB testing device

Testing surge protection devices within data cables
Often, it is necessary to check the functionality of the surge protection devices within the data cable. Of particular importance is that the actual testing of the protection devices has no negative impact on the data signal.

Testing of the arrestor upper parts V50, V25, V20 and V10
The ISOLAB testing unit allows the checking of the arrestor upper parts V50, V25, V20 and V10. A rotary controller allows the selection of the appropriate OBO Bettermann arrestor. Then, the upper part of the appropriate combination and/or surge arrestor is placed in the appropriate opening in the device. The function of the varistor is then checked by pressing the test button. Besides arrestor testing, the ISOLAB also allows insulation testing according to VDE 0100-610.

The Life Control testing unit, developed by OBO Bettermann, allows testing of the protection devices when installed, without influencing the data signal. A thin testing pin creates the contact with the integrated lightning barrier. The integrated microprocessor displays the test result on the OLED display and also emphasises it with acoustic signals. A connectable LED within the testing pin is an additional feature, allowing orientation, even in the darkest switchgear cabinet.
A high-quality testing case for safe transport and the documentation of the testing results are a component part of this innovation from OBO Bettermann.

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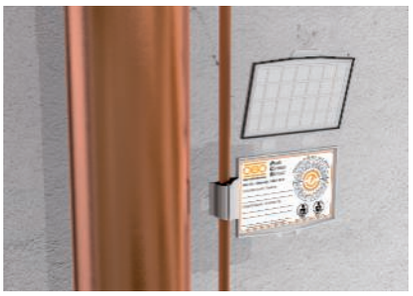


The LSC I+II lightning strike and surge counter measures and permanently saves lightning and pulse currents (10/30, 8/20) and saves this event together with the date and time.

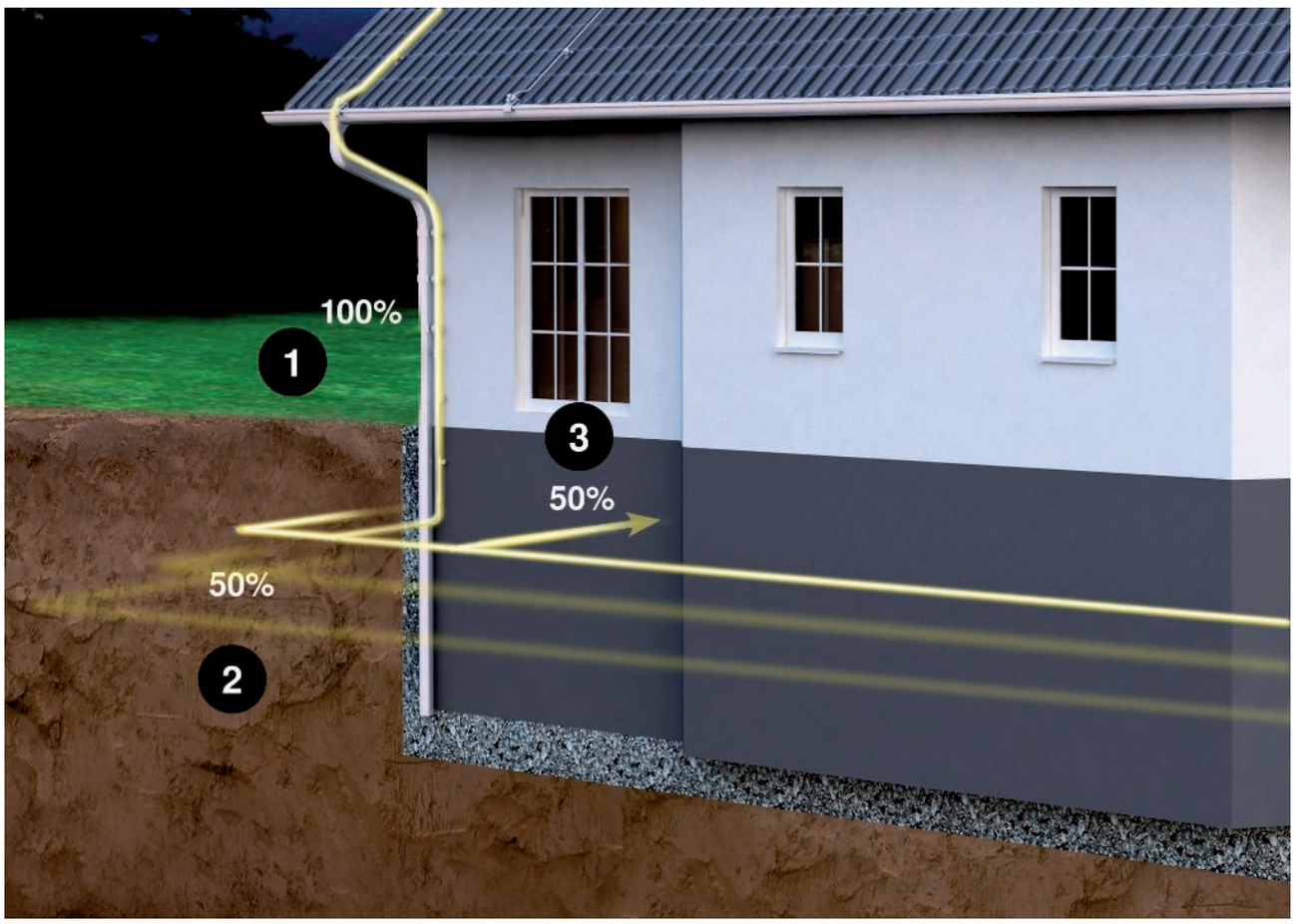
Testing of lightning protection systems with the PCS system

The peak current sensor (PCS) records and stores pulsed currents in the form of a magnetic card. This is a method of monitoring whether lightning has hit the lightning protection and which maximum lightning current has occurred.

If the PCS system is mounted between the interface from equipotential bonding to earthing system, the coupled lightning current in a building can also be measured. The results can provide information on potential damage in the electrical installation. The PCS card is mounted by snapping a card holder onto the round conductor at a defined distance. The measuring range of the card is between 3 and 120 kA. The magnetic card reader offers the option of evaluating peak current sensors. The appropriate peak current value is shown on the display.

Alternatively, OBO Bettermann can read it off for you. In this case please contact your OBO Bettermann agency or subsidiary.

Equipotential bonding planning 38



Path of the lightning current: 1 = 100%, 2 = 50%, 3 = max. 50%

Tasks and function of internal lightning protection

The task of an internal lightning protection system is to prevent dangerous sparking within the building to be protected. Sparking can occur especially when high potential differences with metallic or electrically operated system components occur due to a conductor (arrestor) passing from the lightning current. Electrical energy and information technology systems in particular require special protection, as a direct connection between the external lightning protection system and the building installation exists via the earthing system and the equipotential bonding. In order to avoid damage inside the building, a lightning protection equipotential bonding in accordance with DIN EN 62305 (IEC 62305) is necessary.

System components to be connected

In addition, the following system components must be connected to the equipotential bonding:

- Metal carcass of the structure
- Metal installations
- External conductive components
- Electrical energy and information technology systems

Installing the equipotential bonding

The equipotential bonding should be installed at the basement or at ground level. The electrical energy and information technology lines must be connected to the equipotential bonding via type 1 lightning current arrestors. The arrestors must be connected to the equipotential bonding as close as possible to where the lines enter the building. The surge arrestor connection must comply with DIN VDE 0100-534. The following cross-sections apply as minimum dimensions for connections in the lightning protection equipotential bonding (unless larger cross-sections are specified in other standards):

- Copper: 16 mm²
- Aluminium: 25 mm²
- Steel: 50 mm²

Minimum dimensions of cables, protection class I to IV

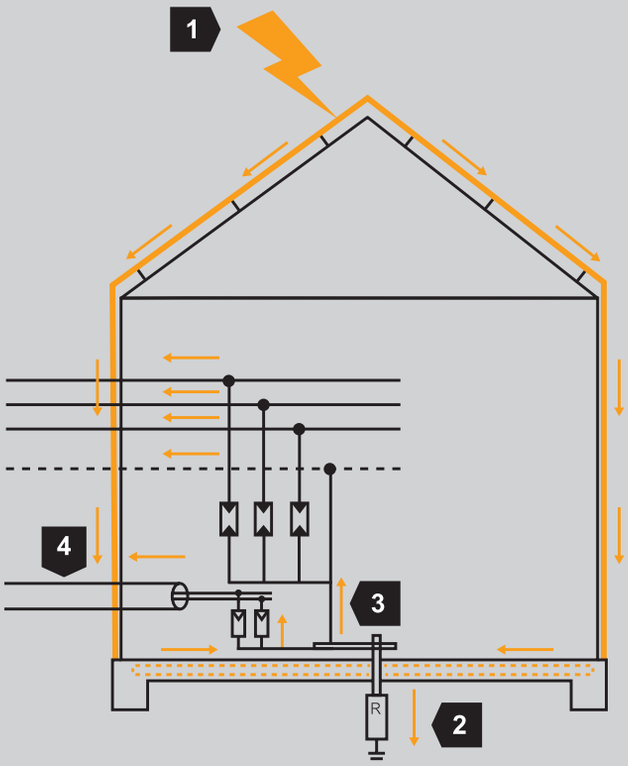
Material	Cross-section of cables, which interconnect different equipotential bonding busbars or which connect to the earthing system	Cross-section of cables, which connect the internal metallic installations with the equipotential bonding busbar
Copper	16 mm²	6 mm²
Aluminium	25 mm²	10 mm²
Steel	50 mm²	16 mm²

Very large surge voltages are caused mainly by lightning strikes on or close to energy systems. Even from several hundred metres away, lightning currents can also cause impermissible surge voltages in conductor loops, through either capacitive, inductive or galvanic coupling. Large surge voltages are coupled over a radius of up to 2 km. Switching operations involving inductive loads create dangerous surge voltages in the medium and low-voltage power networks.

Lightning discharges (LEMP: Lightning Electro Magnetic Impulse)

The international lightning protection standard IEC 62305 describes how direct lightning strikes of up to 200 kA are safely arrested. The current is coupled into the earthing system and, due to the voltage drop at the earthing resistor, half of the lightning current is coupled into the internal installation. The partial lightning current then divides itself among the power lines entering the building (number of cores of power line entering building), while around 5% enters data cables.

The voltage drop at the earthing resistor is calculated from the product of the partial lightning current (i) and the earthing resistance (R). This is then the potential difference between the local earth (equipotential bonding) and the live cables, which are earthed some distance away.



The highest surges are caused by lightning strikes. According to VDE 0185-305 (IEC 62305), lightning strikes are simulated with lightning surge currents of up to 200 kA (10/350 µs).

1	Lightning strike	100 %	limp = max 200 kA (IEC 62305)
2	Earthing system	~ 50%	I = 100 kA (50%)
3	Electrical installation	~ 50%	I = 100 kA (50%)
4	Data cable	~ 5%	I = 5 kA (5%)

Typical distribution of lightning current

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Planning aids, earthing systems

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Installing a foundation earther

The standards specify that each system must include an earthing system.

What do we mean by an "earthing system"?
We can find the required definitions in DIN VDE 0100-200 (IEC 60050-826) – Low-voltage electrical installations: Terms.

- "Totality of the electrical connections and equipment used to earth a network, a system or a resource." Also:
- "Conductive element, embedded in the earth or in another specific conductive medium in electrical contact with the earth."

The tasks of an earthing system are:

- Arresting of the lightning current into the earth
- Equipotential bonding between the down-conductor
- Equipotential bonding near conductive walls of the building structure

Consequences of an improperly created earthing system:

- Dangerous surge voltages at the equipotential bonding
- No even potential course on the earthing system
- Destruction of the foundation through insufficient arresting area of the energy-rich lightning current.
- Destruction of the foundation through improperly made connections (no terminal connection)
- Electrical decoupling of high amounts of lightning energy

Types of earth electrodes as per VDE 0185-305-3

Type A
- Horizontal earther
- Vertical earther (deep earther or earthing rod)

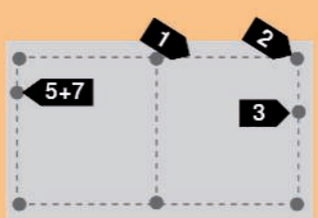
Type B
- Ring earthers (surface earthers)
- Foundation earthers

Planning methods

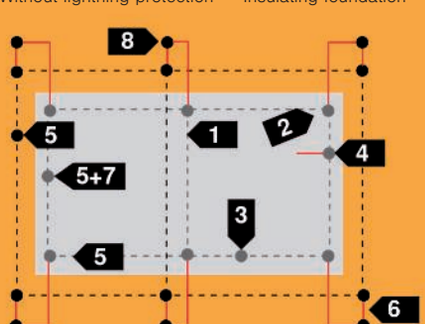
VDE 0185-305-3 (IEC 62305-3) demands continuous lightning protection equipotential bonding. This means individual earthing systems must be connected together to create a global earthing system.

The standard differentiates between type A and type B earthing systems. Type A earthers are vertical or horizontal earthers (deep earthers, earthing rods). A type B earther is any surface earther (ring earthers, foundation earthers).

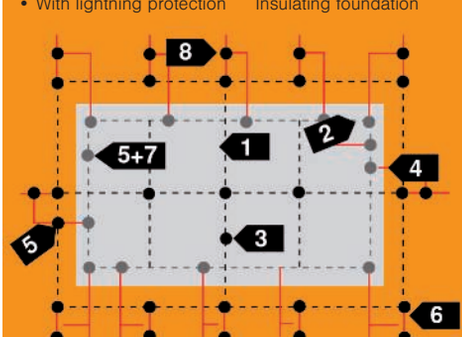
Foundation earther – without lightning protection



Functional equipotential bonding conductor and ring earther
- Without lightning protection Insulating foundation



Functional equipotential bonding conductor and ring earther
- With lightning protection Insulating foundation



Earthing material, for use in concrete:

- Surrounded by min. 5 cm of concrete on all sides; ≤ 2 m connect to reinforcement
- Grid width max. 20 x 20 m; with EMC protection to VDE 0185-305-4: 5 x 5 m
- Unreinforced foundation: Material no. 1.4571/1.4404, V4A

		Type	Item no.	Description
1		5052	5019 34 7	Strip steel 30x3.5 mm FT
2		250 A-FT	5313 01 5	Connector, strip steel with reinforcement FT
3		1814 FT	5014 46 8	Terminal on reinforcement to Ø 14 mm
3		1814 FT D37	5014 46 9	For reinforcements Ø 16–37 mm
4		205 B-M10 VA	5420 00 8	Fixed earthing terminal M10
8		ProtectionBall	5018 01 4	Protective cap for connection straps

Earthing and connection material, for use in the earth or cleanliness layer

- Material no. 1.4571/ 1.4404, V4A; clamps in earth with corrosion protection strip
- Min. 0.8 m deep, routing outside drainage shaft, frost apron (moist area)
- Grid: Without lightning protection: 20 x 20 m, connection between earth and concrete: Every 20 m, with lig earth and concrete: Every down-conductor

		Type	Item no.	Description
5		RD 10 V4A	5021 64 2	Round conductor Ø10 mm V4A
6		250 V4A	5312 92 5	Terminal for round conductor and strip steel

Material for equipotential bonding

		Type	Item no.	Description
7		1801 VDE	5015 65 0	Equipotential busbar, industrial

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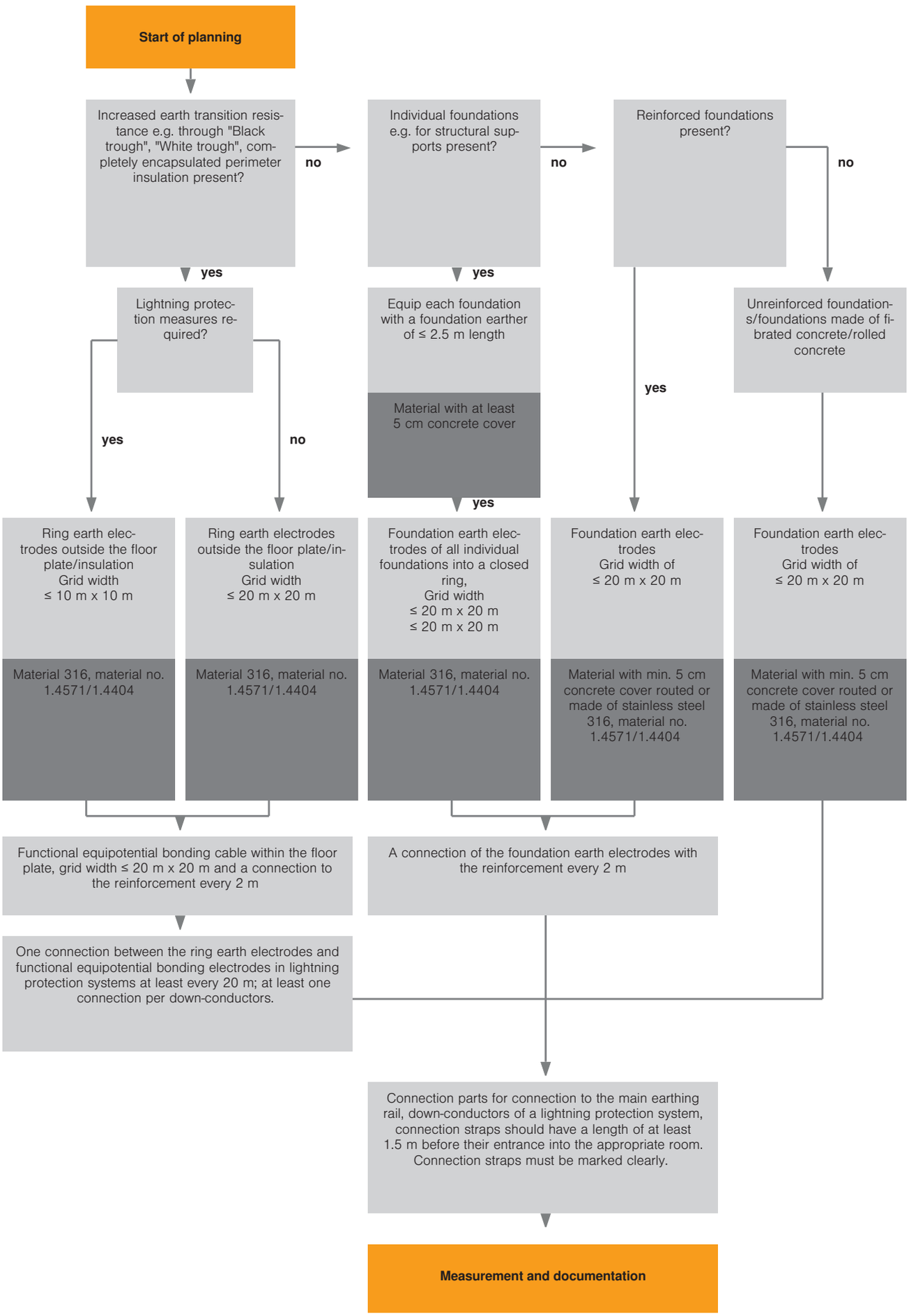
Decision-making aid to determine the grid width of ring or foundation earthers



Selection aid, foundation earthers

Foundation earthers				
Application	Designation	Type	Item no.	Product figure
Foundation earthers for lightning protection measures according to VDE 0185-305-3 (IEC 62305) and for protection measures against electric shocks according to DIN 18014	Flat conductor, galvanised steel, 30 m	5052 DIN 30X3.5	**5019 34 5**	
	Round conductor, galvanised steel, 80 m	RD 10	**5021 10 3**	
	Spacer, 250 mm long, galvanised steel	1 81 1	**5014 01 8**	
	Spacer, 400 mm long, galvanised steel	1811 I	**5014 02 6**	
	Cross-connector for flat conductors and round conductors, galvanised steel	25 0	**5312 90 6**	
	Cross-connector for flat conductor, galvanised steel	256 A-DIN 30 FT	**5314 65 8**	
	Parallel clamp, galvanised steel	259 A FT	**5315 51 4**	
	Connection terminal for reinforcing steels, galvanised steel	1814 FT	**5014 46 8**	
	Round conductor, galvanised steel with PVC jacketing, 75 m	RD 10-PVC	**5021 16 2**	
	Wall penetration, sealed against pressurised water	DW RD10	**2360 04 1**	
	Wall penetration, sealed against pressurised water	DW FL30x3.5	**2360 04 3**	

Selection aid, ring earthers for lightning protection measures

Ring earther				
Application	Designation	Type	Item no.	Product figure
Ring earther for lightning protection measures according to VDE 0185-305-3 (IEC 62305) Not suitable for loamy or wet soil!	Flat conductor, galvanised steel, 30 m	5052 DIN 30X3.5	**5019 34 5**	
	Flat conductor, galvanised steel, 60 m	5052 DIN 30X3.5	**5019 34 7**	
	Round conductor, galvanised steel, 80 m	RD 10	**5021 10 3**	
	Cross-connector for flat conductors and round conductors, galvanised steel	252 8-10 FT	**5312 31 0**	
	Cross-connector for flat conductor, galvanised steel	256 A-DIN 30 FT	**5314 65 8**	
Ring earther for lightning protection measures according to VDE 0185-305-3 (IEC 62305) Usable universally in many environments.	Flat conductor, stainless steel V4A, 25 m	5052 V4A 30X3.5	**5018 73 0**	
	Flat conductor, stainless steel V4A, 50 m	5052 V4A 30X3.5	**5018 70 6**	
	V4A stainless steel round conductor, 50 m	RD 10-V4A	**5021 64 2**	
	V4A stainless steel round conductor, 80 m	RD 10-V4A	**5021 64 7**	
	Cross-connector for flat conductors and round conductors, V4A	252 8-10 V4A	**5312 31 8**	
	Cross-connector for flat conductor, V4A	256 A-DIN 30 V4A	**5314 65 9**	
	Plastic corrosion protection strip, 10 m	356 50	**2360 05 5**	

Selection aid, ring earthers for protection measures against electric shocks

Ring earther				
Application	Designation	Type	Item no.	Product figure
Ring earthers for protection measures against electric shocks according to DIN 18014	Flat conductor, stainless steel V4A, 25 m	5052 V4A 30X3.5	**5018 73 0**	
	Flat conductor, stainless steel V4A, 50 m	5052 V4A 30X3.5	**5018 70 6**	
	V4A stainless steel round conductor, 50 m	RD 10-V4A	**5021 64 2**	
	V4A stainless steel round conductor, 80 m	RD 10-V4A	**5021 64 7**	
	Cross-connector for flat conductors and round conductors, V4A	252 8-10 V4A	**5312 31 8**	
	Cross-connector for flat conductor, V4A	256 A-DIN 30 V4A	**5314 65 9**	
	Plastic corrosion protection strip, 10 m	356 50	**2360 05 5**	

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Lightning protection classes

Lightning protection classes and allocation

Before a lightning protection system is planned, the object to be protected must be assigned to one of four lightning protection classes. Efficiency in lightning protection class I is the highest at 98% and in lightning protection class IV the lowest at 81% (see table of hazard parameters). The cost of erecting a lightning protection system (e.g. necessary protection angles, distances from loops, protection profiles, distances from down-conductors) is more involved for lightning protection class I systems than for lightning protection class IV systems.

VdS Directive

The required lightning protection class is determined by assessing the damage risk in accordance with DIN EN 62305-2 (IEC 62305-2), unless specified in regulations. Directive VdS 2010 (risk-oriented lightning and surge protection), published by Gesamtverband der Deutschen Versicherungswirtschaft e. V. (GDV) offers alternative method of determining the lightning protection class.

You can obtain further information under www.vds.de, via the OBO Hotline +49 (0)2373 89-1700 or at www.obo-bettermann.com.

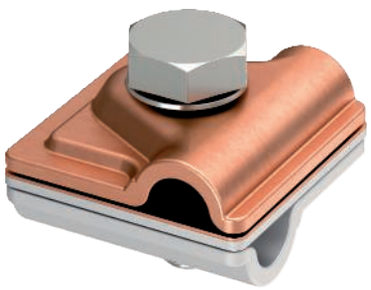
Hazard parameters in dependence of lightning protection classes

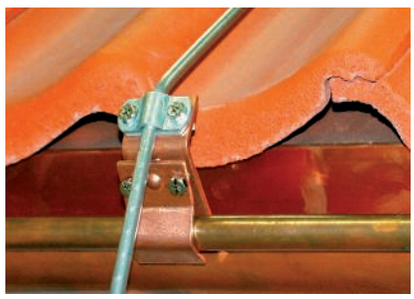
Lightning protection class	Peak lightning current value min.	Peak lightning current value max.	Capture probability
I	3 kA	200 kA	98%
II	5 kA	150 kA	95%
II	10 kA	100 kA	88%
IV	16 kA	100 kA	81%

Lightning protection classes based on Directive VdS 2010

Application	Lightning protection class
Computer centres, military applications, nuclear power stations	I
Ex zones in industry and the chemicals sector	II
Photovoltaic systems > 10 kW	III
Museums, schools, hotels with more than 60 beds	III
Hospitals, churches, storage facilities, meeting places accommodating more than 100 to 200 people	III
Administrative buildings, sales points, offices and bank buildings of over 2,000 m²	III
Residential buildings with more than 20 apartments, multi-storey buildings over 22 m high	III
Photovoltaics (< 10 KW)	III

Materials for external lightning protection





Substances and material
The following materials are preferred for use in external lightning protection systems: hot galvanised steel, rust-proof steel (VA), copper and aluminium.

Corrosion
A risk of corrosion occurs especially when joining different material types. Therefore, no copper parts may be installed above galvanised surfaces or above aluminium parts as copper particles worn away by rain or other environmental influences can penetrate the galvanised surface. In addition, a galvanic element occurs, which accelerates corrosion of the contact surface.

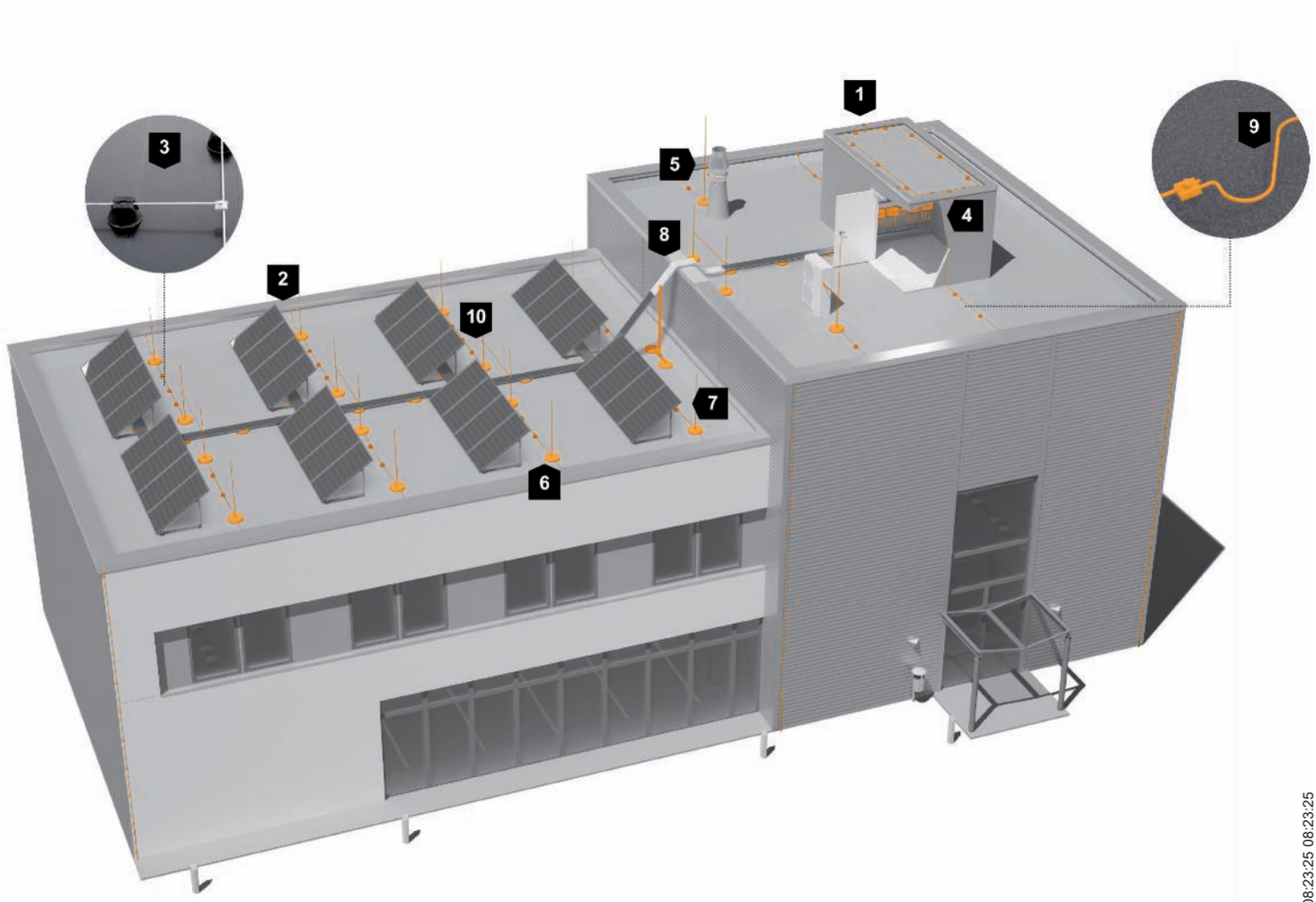
Examples
As you can see from the examples, the copper connection on the steel water pipe is corroded and could become detached. If two different materials that are not recommended need to be joined, bimetal connectors can be used. The example shows the use of bimetal connectors on a copper gutter to which an aluminium round conductor is attached. Points at increased risk of corrosion, such as insertion points into the concrete or soil, must be corrosion-protected. A suitable coating must be applied as corrosion protection to connection points in the ground. Aluminium must not be placed directly (without a distance) on, in or under plaster, mortar or concrete or in the earth – the potential consequences of doing so are shown in our example. In the "Material combinations" table, possible metal combinations are evaluated with regard to contact corrosion in air.

Material combinations without increased risk of corrosion

	Steel, galvanised	Aluminium	Copper	Stainless steel	Titanium	Tin
Steel, galvanised	Yes	Yes	No	Yes	Yes	Yes
Aluminium	Yes	Yes	No	Yes	Yes	Yes
Copper	No	No	Yes	Yes	No	Yes
Stainless steel	Yes	Yes	Yes	Yes	Yes	Yes
Titanium	Yes	Yes	No	Yes	Yes	Yes
Tin	Yes	Yes	Yes	Yes	Yes	Yes

Installation principle, building with flat roof

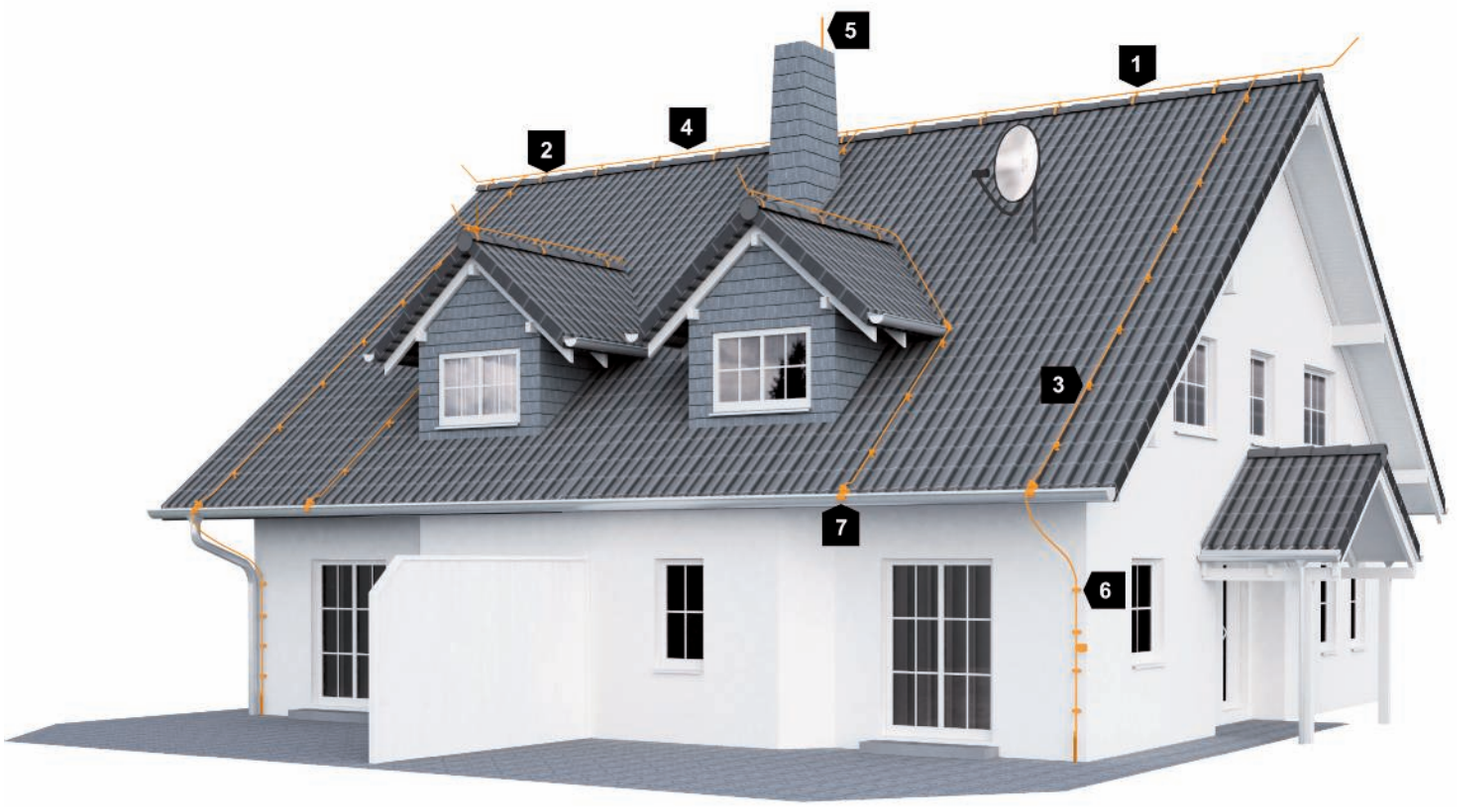
In buildings with flat roofs, the grid method is generally used. Roof structures such as PV systems, air-conditioning units, roof dome lights and ventilators are protected with additional air-termination rods.



1	Terminal block
2	Bridging component
3	Roof conductor holder
4	Cable bracket
5	Insulated spacer
6	Air-termination system stand
7	Air-termination rod
8	Fire protection bandage over insulated parapet cover
9	Expansion piece
10	Vario quick connector

Installation principle, building with a pitched/gabled roof

The exposed points, e.g. the ridge, chimneys and any roof structures, must be protected with air-termination systems.



1	Roof conductor holder for ridge tiles
2	Vario quick connector
3	Roof conductor holder
4	Round conductor
5	Air-termination rod
6	Cable bracket
7	Gutter clamp

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The wind load describes how wind will affect the buildings and installed systems. It must be taken into account during planning.

Determining the wind load

For decades, wind load has been an important consideration for OBO Bettermann in relation to external lightning protection. Today's calculation models and air-termination rod systems are the result of numerous studies and years of R&D experience.

The previous German standards in this area – DIN 1055:2005 Part 4: Wind loads and Part 5: Snow and ice loads, and DIN 4131: Steel antenna mounts – dealt with all load assumptions for mounts in Germany.

The Eurocodes (EC) are the result of European standardisation in the construction field. EC 0 to EC 9 cover the documents in the series DIN EN 1990 to 1999. These are supplemented by the various national annexes (NA). The NAs contain provisions that go beyond the Eurocode rules, i.e. the provisions that were previously part of the national standards.

Following the publication of the national annexes to the ECs, the old standards became invalid, following appropriate coexistence phases.

New standard
Eurocode 1: DIN EN 1991-1-4:2010-12: Parts 1-4: General effects; wind loads + DIN EN 1991-1-4/NA: 2010-12
DIN EN 1991-1-3: 2010-12 -; Parts 1-3: General effects; snow loads + DIN EN 1991-1-3/NA: 2010-12
Eurocode 3: DIN EN 1993-3-1: 2010-12: Parts 3-1: Towers, masts and chimneys – Towers and masts + DIN EN 1993-3-1/NA: 2010-12

Example of German national standards for the calculation of wind load

1st step: Determining the wind zone
The second factor that needs to be known when determining the wind load is the wind load zone in which the object is located.

The standards contain no statements regarding the following aspects:
- Framework masts and towers with non-parallel main legs,
- Guyed masts and chimneys,
- Cable-stayed and suspension bridges,
- Torsional vibrations.

Zone	Wind speed in m/s	Speed pressure in kN/m²
1	22.5	0.32
2	25.0	0.39
3	27.5	0.47
4	30.0	0.56

Basic speeds and speed pressures

Wind zones in Germany according to DIN EN 1991-1-4 NA

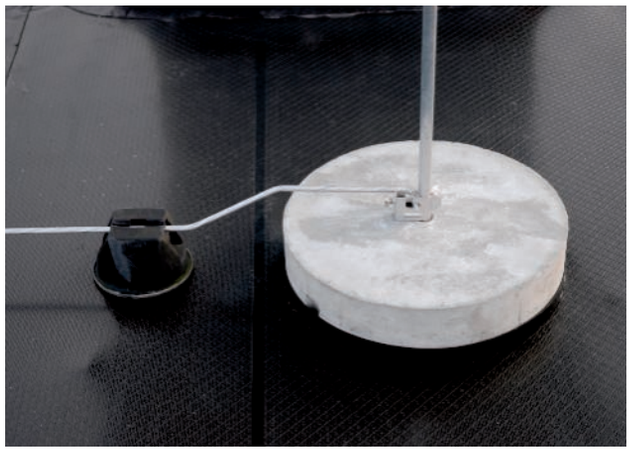
2nd step: Determining the terrain category (TC)
Terrain-specific loads and dynamic pressures are an important element in calculating wind loads.

Terrain category (TC)	Definition
Terrain category I	Open sea; lakes with at least 5 km of open water in the wind direction; even, flat land without obstacles
Terrain category II	Terrain with hedges, individual farmsteads, buildings or trees, e.g. agricultural area
Terrain category III	Suburbs, industrial or commercial areas; forests
Terrain category IV	Urban areas in which at least 15% of the area is built up with buildings whose average height is higher than 15 m

Table 2.10: Terrain categories according to DIN EN 1991-1-4

3rd step: Determining the maximum gust speed

The tilt and slip resistance of air-termination rods must always be determined on a project-by-project basis. The reference height is the building height and two thirds of the length of the air-termination rod. The maximum gust speed at the project location must be determined.



Air-termination rod with stand

Gust speed in wind zone I				
Reference height in metres	**TC I in kph**	**TC II in kph**	**TC III in kph**	**TC IV in kph**
0	112	105	100	93
5	122	108	100	93
10	136	124	103	93
16	136	124	111	93
20	139	128	115	98
30	145	134	122	106
40	149	139	128	112
70	157	148	139	126
100	162	155	147	135

Gust speeds, wind zone I

Gust speed in wind zone II				
Reference height in metres	**TC I in kph**	**TC II in kph**	**TC III in kph**	**TC IV in kph**
0	124	117	111	104
5	136	120	111	104
10	145	131	114	104
16	152	138	123	104
20	155	142	127	109
30	161	149	136	118
40	165	154	142	125
70	174	165	155	139
100	180	172	163	150

Gust speeds, wind zone II

Gust speed in wind zone III				
Reference height in metres	**TC I in kph**	**TC II in kph**	**TC III in kph**	**TC IV in kph**
0	137	129	122	114
5	149	132	122	114
10	159	144	126	114
16	167	152	135	114
20	170	156	140	119
30	177	164	149	129
40	182	170	156	137
70	192	181	170	153
100	198	189	180	165

Gust speeds, wind zone III

Gust speed in wind zone IV				
Reference height in metres	**TC I in kph**	**TC II in kph**	**TC III in kph**	**TC IV in kph**
0	149	140	133	124
5	163	144	133	124
10	174	157	137	124
16	182	166	148	125
20	186	170	153	130
30	193	179	163	141
40	198	185	170	150
70	209	198	185	167
100	216	206	196	180

Gust speeds, wind zone IV

4th step: Determining what concrete blocks are required
Based on the maximum gust speed, the number and size (10 or 16 kg) of concrete blocks required can be determined for the air-termination rod used. The value in the tables must lie above the maximum gust speed for the location.

An example
The maximum gust speed at the location is 142 km/h.

A tapered pipe air-termination rod of type 101 VL2500 and height 2.5 m is used.

Because the value in Table 6 must be higher than the maximum gust speed at the location (i.e. in this case more than 142 km/h), the next possible value is 164. Three concrete blocks, each of weight 16 kg, must therefore be used.

Number of concrete blocks for tapered pipe air-termination rods

Air-termination rod height in m	1.5	2	2.5	3	3.5	4	**Concrete blocks required**
Type	101 VL1500	101 VL2000	101 VL2500	101 VL3000	101 VL3500	101 VL4000	
Item no.	5401 98 0	5401 98 3	5401 98 6	5401 98 9	5401 99 3	5401 99 5	
Wind speed kph	117	-	-	-	-	-	**1 x 10 kg**
	164	120	95	-	-	-	**2 x 10 kg**
	165	122	96	-	-	-	**1 x 16 kg**
	-	170	135	111	95	-	**2 x 16 kg**
	-	208	164	136	116	102	**3 x 16 kg**

Number of concrete blocks for air-termination rod, one end rounded

Air-termination rod height in m	1	1.5	2	2.5	3	**Concrete blocks required**
Type	101 ALU-1000	101 ALU-1500	101 ALU-2000	101 ALU-2500	101 ALU-3000	
Item no.	5401 77 1	5401 80 1	5401 83 6	5401 85 2	5401 87 9	
Wind speed kph	97	-	-	-	-	**1 x 10 kg**
	196	133	103	-	-	**1 x 16 kg**
	-	186	143	117	100	**2 x 16 kg**
	-	-	173	142	121	**3 x 16 kg**

Number of concrete blocks for air-termination rod, one end rounded with connection strap

Air-termination rod height in m	1	1.5	**Concrete blocks required**
Type	101 A-L 100	101 A-L 150	
Item no.	5401 80 8	5401 85 9	
Wind speed kph	100	-	**1 x 10 kg**
	192	129	**1 x 16 kg**
	-	177	**2 x 16 kg**
	-	214	**3 x 16 kg**

Number of concrete blocks for insulated VA and Al air -ermination rods

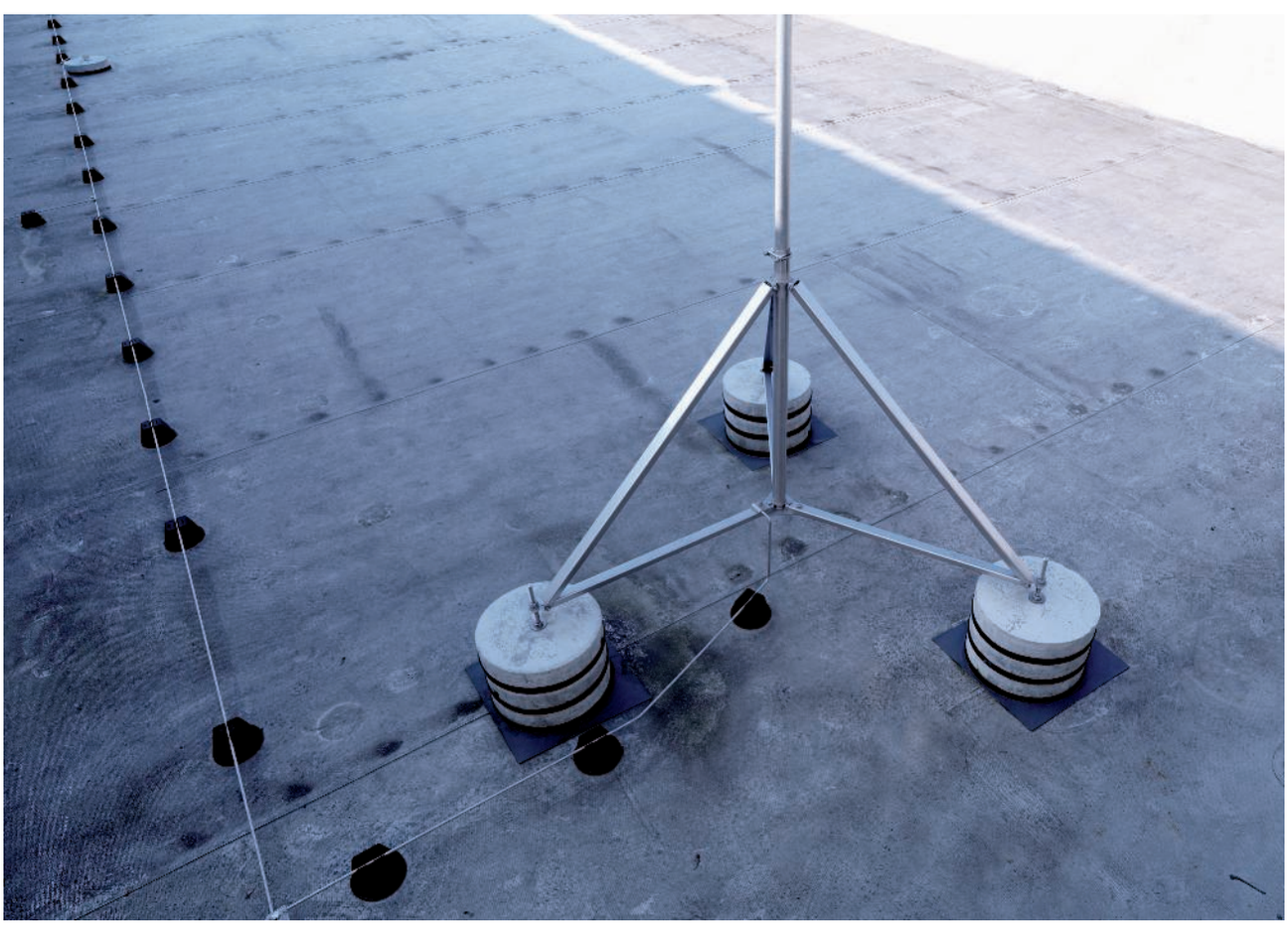
Air-termination rod height in m	4	6	4	6	**Concrete blocks required**
Material	VA	VA	Al	Al	
Item no.	5408 94 2	5408 94 6	5408 94 3	5408 94 7	
Item no. of appropriate interception rod stand	5408 96 8	5408 96 9	5408 96 6	5408 96 7	
Wind speed kph	120	94	120	92	**3 x 16 kg**
	161	122	163	122	**6 x 16 kg**
	194	145	197	147	**9 x 16 kg**
	222	165	227	168	**12 x 16 kg**
	246	182	252	187	**15 x 16 kg**

Number of concrete blocks for insulated air-termination rods with exit

Air-termination rod height in m	4	6	8	10	**Concrete blocks required**
Item no.	5408 93 8	5408 94 0	5408 88 8	5408 89 0	
Item no. of appropriate interception rod stand	5408 93 0	5408 93 2	5408 90 2	5408 90 2	
Wind speed kph	110	85	93	82	**3 x 16 kg**
	148	111	116	102	**6 x 16 kg**
	178	132	134	119	**9 x 16 kg**
	204	151	151	133	**12 x 16 kg**
	227	167	166	146	**15 x 16 kg**

Number of concrete blocks for isFang air-termination rod with VA tri-pod

Air-termination rod height m	4	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	**Required concrete blocks**
Air-termination rod item no.	5402 86 4	5402 86 6	5402 86 8	5402 87 0	5402 87 2	5402 87 4	5402 87 6	5402 87 8	5402 88 0	
Matching Air-termination rod stand Item no.	5408 96 8	5408 96 8	5408 96 8	5408 96 8	5408 96 9	5408 96 9	5408 96 9	5408 96 9	5408 96 9	
Wind speed km/h	143	124	110	99	104	96	89	83	78	**3 x 16 kg**
	193	168	148	133	138	127	117	109	102	**6 x 16 kg**
	232	202	178	159	165	151	139	129	121	**9 x 16 kg**
	266	231	203	182	188	172	159	147	138	**12 x 16 kg**
	296	257	226	202	208	191	176	163	152	**15 x 16 kg**



Planning aids, insulated lightning protection

isFang air-termination rod system	62
OBO isCon® system	
Air-termination and down-conductor system	64
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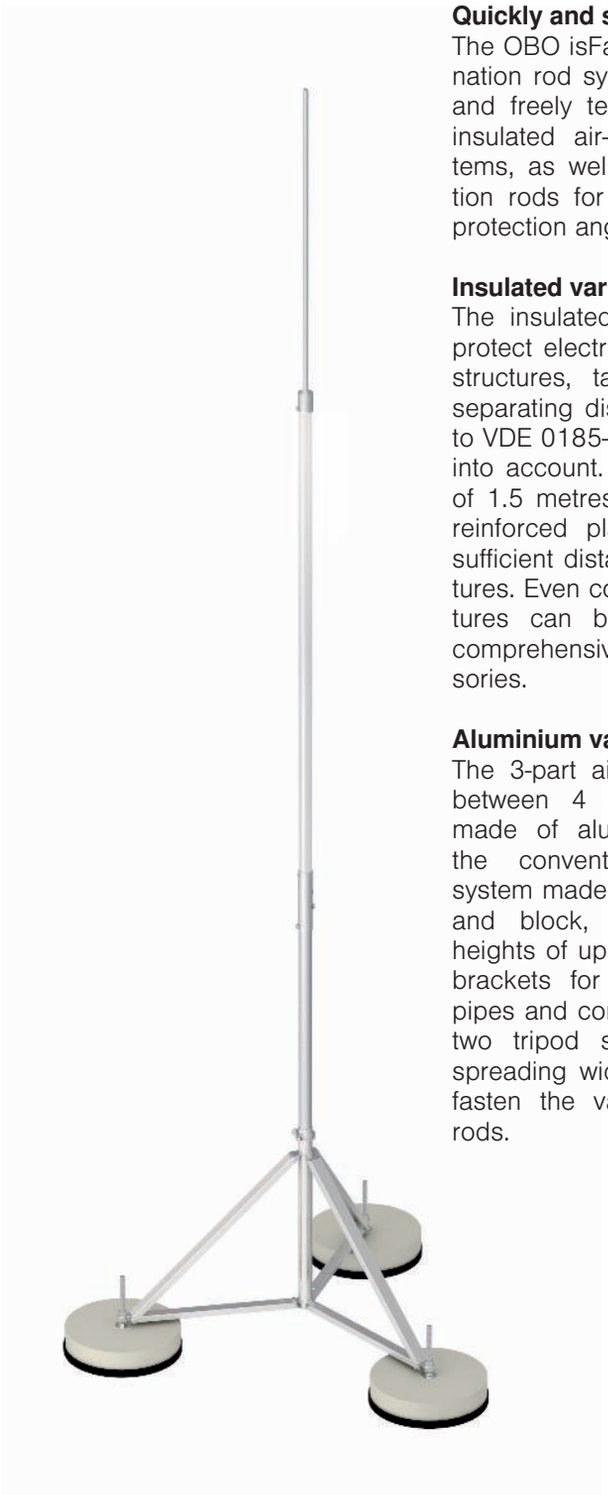
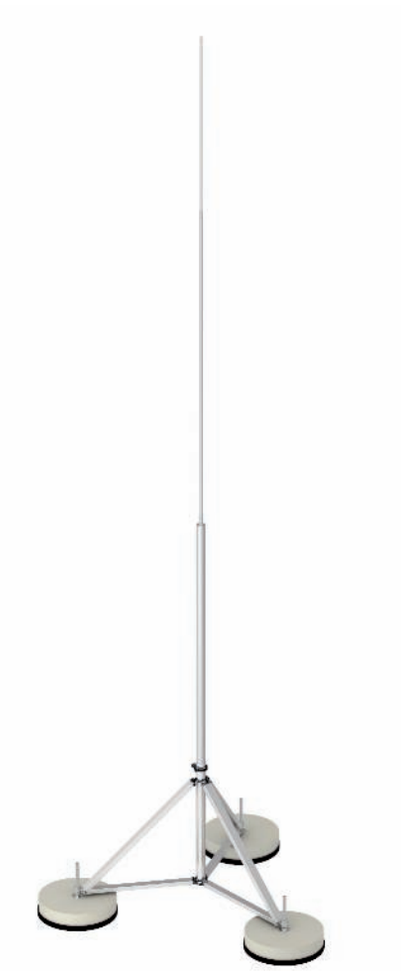
isFang air-termination rod system



Quickly and simply installed
The OBO isFang modular air-termination rod system can offer a fast and freely terminable solution for insulated air-termination rod systems, as well as high air-termination rods for the largest possible protection angle.

Insulated variant
The insulated air-termination rods protect electrical and metallic roof structures, taking the calculated separating distance (s), according to VDE 0185-305-3 (IEC 62305-3), into account. An insulated section of 1.5 metres made of fibre-glass reinforced plastic (GFK) ensures sufficient distance to all roof structures. Even complex building structures can be protected by the comprehensive system accessories.

Aluminium variant
The 3-part air-termination rods of between 4 and 8 metres and made of aluminium complement the conventional air-termination system made of air-termination rod and block, which is used for heights of up to 4 metres. Various brackets for mounting on walls, pipes and corner pipes, as well as two tripod stands with different spreading widths, are available to fasten the various air-termination rods.



OBO isCon® system

1	Weakly conductive EVA (ethylene vinyl acetate copolymer), UV-resistant
2	Conductive PEX (cross-linked polyethylene)
3	Insulating PEX (cross-linked polyethylene)
4	35 mm² copper cable

Structure of the high-voltage-resistant OBO isCon® insulated down-conductor

In complex installations, the required separating distance can often no longer be implemented with conventional down-conductors, as the structural conditions do not permit the required distances between the air-termination systems and the electrical installations. Insulated lightning protection systems, such as the OBO isCon® conductor, are used to maintain the required separating distance.

Tested: 0.75 m separation distance and up to 150 kA lightning current

After first potential connection behind the connection element, the isCon® cable reflects an equivalent separation distance of up to 0.75 metres in the air according to VDE 0185-305-3 (IEC 62305). This means that installation is possible directly on metallic and electrical structures. There is no direct arcing between the down-conductor and the building to be protected.

Total flexibility on the construction site

The OBO isCon® conductor can be used flexibly. The isCon® conductor is delivered on disposable cable rolls. This means that the user can cut them to the exact size they require and terminate them as necessary. This means: no ordering of pre-terminated conductors, but rather flexible working according to actual conditions on the construction site. Special knowledge is required to be able carry out the planning and routing of the isCon® correctly. This knowledge is imparted by the current installation instructions, but can also be deepened in special OBO workshops.

OBO isCon®-System: air-termination system and down-conductor

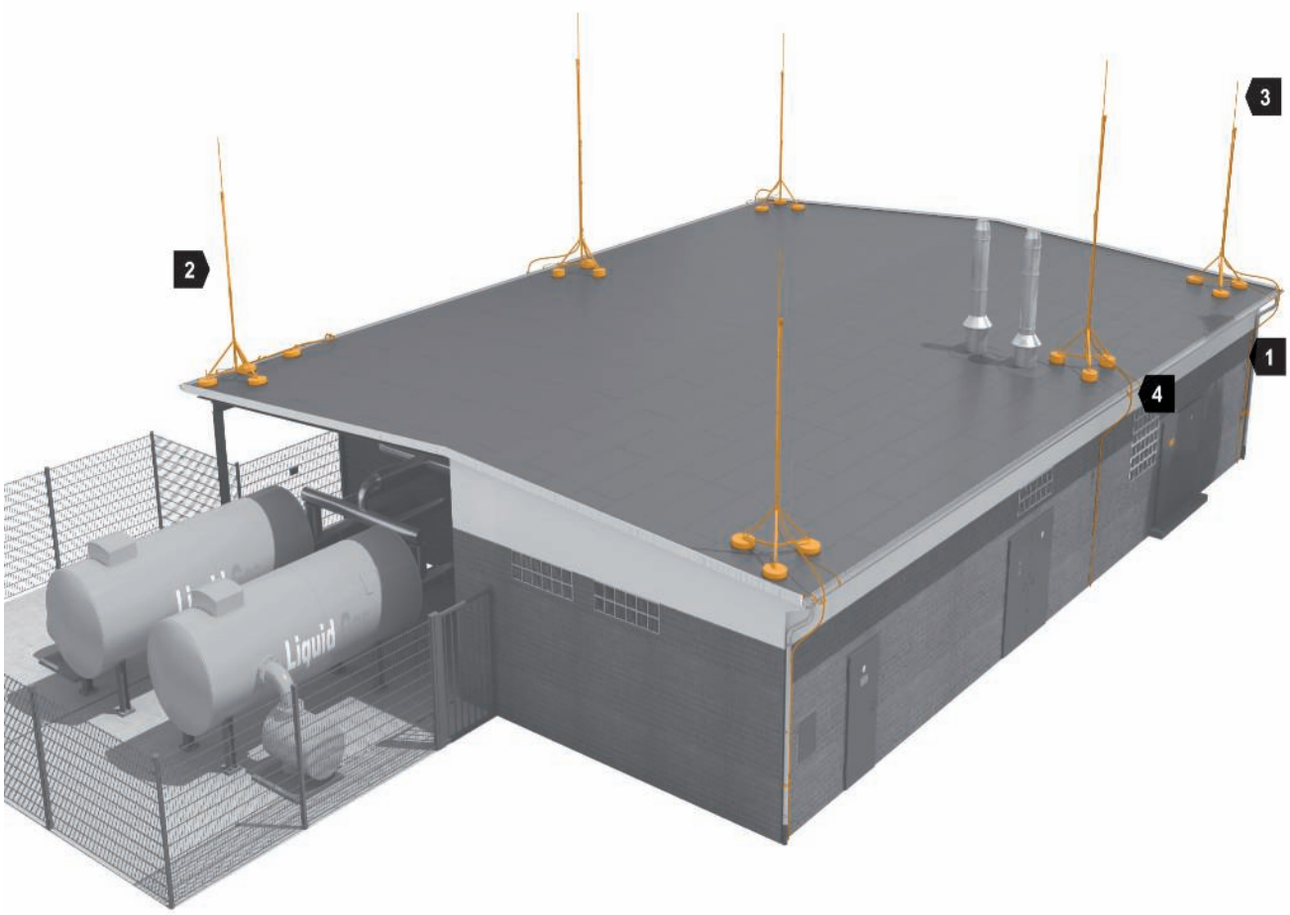
The air-termination system
The routing of the air-termination system is planned taking DIN EN 62305-3 (VDE 0185-305-3) Section 5.2 into account. The area to be protected must be designed specially according to the height and arrangement of the air-termination system.

The down-conductor
Only the connection element may be connected to the air-termination or forwarding down-conductor of the external lightning protection. The cable must be located in the protection area of the air-termination system and be fastened at a maximum distance of one metre using the installation material indicated. If cables are routed in the building, then specified protection measures, such as fire insulation, must be taken into account.

Separation distance
Calculation of the separating distance according to DIN EN 62305-3 (VDE 0185-305-3) Section 6.3 at the point the isCon® conductor is connected. The length (l) should be measured from the connection point of the isCon® conductor to the next level of the lightning protection equipotential bonding (e.g. earthing system). Check whether the calculated separating distance (s) is less than the specified equivalent separating distance of the isCon® conductor. If the specified separating distance is exceeded, then additional down-conductors must be installed.

Installation principle, isCon in potentially explosive areas

In the Ex zones 1 and 21, after the first potential connection, the OBO isCon® conductor should be connected at regular distances (0.5 metres) using a metallic cable bracket (e.g. isCon H VA or PAE) to the equipotential bonding. If there is a lightning strike, lightning current may not flow through the equipotential bonding and it must be in the protection angle of the lightning protection system.



1	isCon® conductor
2	4 m isFang air-termination rod with external isCon® conductor
3	6 m isFang air-termination rod with external isCon® conductor
4	Potential connection

OBO isCon® system: Ex areas

Installation in potentially explosive areas
When planning and running a lightning protection system through Ex zones, the following rules must particularly be taken into account:

- DIN EN 62305-3 – Appendix D – "Additional information for lightning protection systems for structure in areas with the risk of explosion"
- VDE 0185-305-3 – Supplementary sheet 2 – "Additional information for special structures"

For Ex systems with Ex zone 2 and 22, supplementary sheet 2 (VDE 0185-305-3, Point 4.3) states that an Ex atmosphere will only occur in rare, unforeseen circumstances. Therefore, it is possible to position interception units in Ex zone 2 and 22, taking Appendix D in DIN EN 62305-3 (VDE 0185-305-3) into account.

In the Ex zones 1 and 21, after the first potential connection, the OBO isCon® conductor should be connected at regular distances (0.5 metres) using a metallic conductor bracket (e.g. isCon H VA or PAE) to the equipotential bonding. If there is a lightning strike, lightning current may not flow through the equipotential bonding and it must be in the protection angle of the lightning protection system.

Secure screw connectors against loosening.

OBO isCon® system: application examples

Application example: soft-covered roofs
Soft-covered roofs, for example with straw, thatch or reeds, require increased protection against lightning strikes and the resulting risk of fire.
In order to meet the aesthetic requirements of the client, a lightning protection system using an isCon® conductor is recommended. The air-termination system is implemented using interception rods, which allow the conductor to be routed in their interior (type isFang IN). The grey variant of the isCon® conductor guarantees a high degree of protection and should be used for soft roofs. In this way, the conductor can be routed under the soft roof.

Observe the OBO isCon® system manual for detailed mounting instructions.

Application example: mobile telecommunications system
Installations such as mobile telecommunications systems must be included in the lightning protection concept, particularly in the case of refitting work.
Spatial restrictions, as well as the influence of transmission signals, can be overcome by constructing the lightning protection system using an isCon® conductor. Simple inclusion in the existing lightning protection system as well as separate lightning protection can be implemented simply and in accordance with the standards.

Aesthetic aspects
In easily visible areas, as well as wherever aesthetics are important, we recommend routing the isCon® conductor in air-termination rods. Equipotential bonding after the first 1.5 metres takes place in the rod. The entire retaining pipe is earthed, guaranteeing comprehensive equipotential bonding. A simple and visually perfect installation solution.

Test marks

	Lightning current-tested
	Lightning current-tested, Class H (100 kA)
	ELEKTROTECHNICKÝ ZKUŠEBNÌ ÚSTAV, Czech Republic
	ATEX certificate for explosive areas
	Russia, GOST The State Committee for Standards
	KEMA-KEUR, Netherlands
	Indication of metric products
	MAGYAR ELEKTROTECHNIKAI ELLENŐRZŐ INTÉZET Budapest, Hungary
	Österreichischer Verband für Elektrotechnik, Austria
	Underwriters Laboratories Inc., USA
	Eidgenössisches Starkstrominspektorat, Switzerland
	Underwriters Laboratories Inc., USA
	Verband der Elektrotechnik, Elektronik, Informationstechnik e.V., Germany
	German Association of Electricians, tested safety
	5-year warranty
	Halogen-free; without chlorine, fluorine and bromine
	INMETRO, Brazil

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Pictogram explanation

Lightning protection classes

Type 1	Protection device to DIN EN 61643-11 or IEC 61643-11
Type 1+2	Combination protection device made of type 1 and type 2
Type 2	Protection device to DIN EN 61643-11 or IEC 61643-11
Type 2+3	Protection device to DIN EN 61643-11 or IEC 61643-11
Type 3	Protection device to DIN EN 61643-11 or IEC 61643-11

Lightning protection zone

LPZ 0→1	Transition from LPZ 0 to LPZ 1
LPZ 0→2	Transition from LPZ 0 to LPZ 2
LPZ 0→3	Transition from LPZ 0 to LPZ 3
LPZ 1→2	Transition from LPZ 1 to LPZ 2
LPZ 1→3	Transition from LPZ 1 to LPZ 3
LPZ 2→3	Transition from LPZ 2 to LPZ 3

Applications

FS	Remote signalling
AS	Acoustic signalling
ISDN	Integrated Service Digital Network, ISDN applications
DSL	Digital Subscriber Line, DSL applications
Analog TK	Analogue telecommunication
Cat 5	Category 5 TwisterPair
Cat 6_A	Channel Performance to American EIA/TIA standard
MSR	Measuring, controlling and regulating systems
TV	TV applications
SAT	SAT-TV applications
Mu	MultiBase base
	LifeControl
EX	Intrinsically safe protection device for areas with a risk of explosions
Class E_A	Channel Performance to ISO / IEC 11801
PoE	Power over Ethernet
230/ 400 V System	230/400 V system
IP 54	Protection rating IP 54
IP 65	Protection rating IP 65

Metals

Alu	Aluminium
VA	Stainless steel, grade 304
VA	Stainless steel, grade 316
VA	Stainless steel, grade 316 L
VA	Stainless steel, grade 316 Ti
Cu	Copper
CuZn 37	Brass
St	Steel
TG	Cast iron
Zn	Die-cast zinc

Plastics

GFK	Fibre-glass-reinforced plastic
P	Petrolatum
PA	Polyamide
PC	Polycarbonate
PE	Polyethylene
PP	Polypropylene
PS	Polystyrene

Surfaces

FS	Strip-galvanised
F	Hot-dip galvanised
G	Electro-galvanised
FT	Hot-dip galvanised
Cu	Copper-plated
N	Nickel-plated
ZD	Galvanised, Deltatone 500

Metallic materials

Alu — Aluminium

VA (1.4301) — Stainless steel, grade 304

VA (1.4401) — Stainless steel, grade 316

VA (1.4404) — Stainless steel, grade 316 L

VA (1.4571) — Stainless steel, grade 316 Ti

Cu — Copper

CuZn — Brass

St — Steel

TG — Cast iron
Electro-galvanised

Zn — Die-cast zinc

GFK — Fibre-glass-reinforced plastic

Temperature resistance:
-50 to 130 °C.
Resistant to
High chemical resistance
Corrosion resistance
UV light resistance

PETR — Petrolatum

PA — Polyamide

Temperature resistance:
permanently up to approx. 90 °C, briefly up to about 130 °C and to about minus 40 °C*.
Chem. resistance generally as for polyethylene.
Resistant to
Petrol, benzene, diesel oil, acetone, solvents for paints and lacquers, oils and greases.
Unstable with
Bleach, most acids, chlorine.
Risk of tension cracking
Low in air-humid conditions; only with some aqueous salt solutions. Highly desiccated parts (high temperature and extremely low air humidity) are highly sensitive to fuels and various solvents.

PA/PP — Polyamide/Polyethylene

PC — Polycarbonate

Temperature resistance:
permanently up to approx. 110 °C (in water 60 °C), briefly up to 125 °C, and to below minus 35 °C.
Resistant to
Petrol, turpentine, most weak acids.
Unstable with
Acetone, benzene, chlorine, methylene chloride, most concentrated acids.
Risk of tension cracking
Relatively low.
Media which can cause tension cracking include benzene, aromatic hydrocarbons, methanol, butanol, acetone, turpentine.

PE — Polyethylene

Temperature resistance:
hard types permanently up to about 90 °C, briefly up to about 105 °C, soft types permanently up to about 80 °C, briefly up to about 100 °C and to about minus 40 °C*.
Resistant to
Alkalis and inorganic acids.
Conditionally resistant to
Acetone, organic acids, petrol, benzene, diesel oil, most oils.
Unstable with
Chlorine, hydrocarbons, oxidising acids.
Risk of tension cracking
Relatively high.
Stress cracks can be caused by, among other things, acetone, various alcohols, formic acid, ethanol, petrol, benzene, butyric acid, acetic acid, formaldehyde, various oils, petroleum, propanol, nitric acid, hydrochloric acid, sulphuric acid, soap solutions, turpentine, trichloroethylene, citric acid.

PP — Polypropylene

Temperature resistance:
permanently up to approx. 90 °C, briefly up to about 110 °C and to about minus 30 °C*.
Chem. resistance generally as for polyethylene.
Resistant to
Alkalis and inorganic acids.
Conditionally resistant to
Acetone, organic acids, petrol, benzene, diesel oil, most oils.
Unstable with
Chlorine, hydrocarbons, oxidising acids.
Risk of tension cracking
Low, only with some acids such as chromic acid, hydrofluoric acid and hydrochloric acid, as well as nitrogen oxide.

PS — Polystyrene

Temperature resistance:
Because of its relatively high sensitivity to the effects of chemicals, its use is not recommended at temperatures above normal room temperature, about 25 °C.
Resistance to cold: to about minus 40 °C*.
Resistant to
Alkalis, most acids, alcohol.
Conditionally resistant to
Oils and greases.
Unstable with
Butyric acid, concentrated nitric acid, concentrated acetic acid, acetone, ether, petrol and benzene, solvents for paints and lacquers, chlorine, diesel fuel.
Risk of tension cracking
Relatively high.
Stress cracks can be caused by, amongst other things, acetone, ether, petrol, cyclohexane, heptane, methanol, propanol and the softeners used in some PVC cable mixes.

*The minus values apply only for parts in the quiescent condition with no severe impact stress.
There is no plastic that is resistant to every chemical. The agents listed are only a small selection. Plastic parts are especially at risk in the presence of chemicals and high temperatures. Stress cracks may occur. If in doubt, please consult us and/or ask for a detailed chemical resistance table.
Stress crack formation: stress cracks may occur if plastic parts under tension are exposed to chemicals at the same time. Parts made of polystyrene and polyethylene are particularly susceptible. Stress cracks may even be caused by agents to which the plastic in question is resistant in the absence of stress. Typical examples of parts under constant stress when used as intended: grip clips, intermediate supports of cable glands, ribbon clips.

Tightening torques

M5 = 4 Nm

M6 = 6 Nm

M8 = 12 Nm

M10 = 20 Nm

Detailed data can be provided on request.

Brief glossary of overvoltage protection

100% response lightning impulse voltage

The 100% response lightning impulse voltage is the value of the lightning impulse voltage 1.2/50 µs, causing the arrestor to switch. With this testing voltage, the surge protection device must respond ten times to ten loads.

Arrestor

Arrestors are resources, which primarily consist of voltage-dependent resistors and/or spark gaps. Both elements can be switched in series or in parallel or used individually.
Arrestors are used to protect other electrical resources and electrical systems against surge voltages.

Arrestor measured voltage Vc

For arrestors without a spark gap, the measured voltage is the maximum permitted effective value of the mains voltage on the arrestor terminals. The measured voltage may constantly be applied to the arrestor without changing its operational characteristics.

Back-up fuse before the arrestors

There must be a back-up fuse before the arrestors. If the upstream fuse is greater than the maximum approved back-up fuse of the arrestor elements (see technical data of the device), the arrestor must be protected selectively with the required value.

Cut-off unit

The cut-off unit cuts the arrestor off from the mains or the earthing system if it is overloaded, thus preventing a fire risk and also signalling the switch-off of the protection device.

Equipotential bonding

Electrical connection, which brings the bodies of electrical resources and other conductive parts to the same or almost the same potential.

Equipotential busbar (PAS)

A terminal or rail, intended to connect the protective conductor, the equipotential bonding conductor and, if necessary, the conductor for function earthing with the earthing cable and the earthers.

Error current protection unit (RCD)

Resource for protection against electric shocks and fire protection (e.g. FI protection switches).

Lightning protection equipotential bonding system

The lightning protection equipotential bonding is a key measure in reducing the risk of fire and explosion on the room or building to be protected. The lightning protection equipotential bonding is achieved using equipotential bonding cables or arrestors, which connect the external lightning protection system, metallic parts of the building or room, the installation, the other conductive parts and the electrical energy and telecommunications systems.

Lightning protection system (LPS)

A lightning protection system (LPS) is considered as the entire system used to protect a room or building against the impact of a lightning strike. This includes both internal and external lightning protection.

Lightning protection zone (LPZ)

Lightning protection zones are those areas in which the electromagnetic environment of the lightning is to be defined and mastered. At the zone transitions, all cables and metallic parts must be integrated into the equipotential bonding system.

Lightning surge current (limp)

A lightning surge current (lightning current carrying capacity per path) is a standardised surge current curve of the shape 10/350 µs. With its parameters
- Peak value
- Charge
- Specific energy

it represents the load from natural lightning currents. Type 1 lightning current arrestors (previously requirement class B) must be able to arrest such lightning currents without being destroyed.

Line follow current quenching (If)

The follow current – also called network follow current – is the current which flows through the surge protection device after an arresting operation and is supplied by the network. The follow current is considerably different from the continuous operating current. The level of the network follow current is dependent on the feed line from the transformer to the arrestor.

Nominal current (In)

The nominal current is the maximum permitted operating current which may be run continually through the appropriately labelled connection terminals.

Nominal discharge surge current (In)

Peak value of the current flowing through the arrestor with the wave shape 8/20. It is used to classify the testing of surge arrestors of type 2 (formerly requirements Class C).

Nominal frequency (fn)

The nominal frequency is that frequency for which a resource is measured, by which it is called and upon which other nominal parameters refer.

Nominal voltage (Vn)

The rated voltage is the voltage value for which a resource is designed. In so doing it might be a direct voltage value or the effective value of a sine-form alternating voltage.

Surge protection device (SPD)

A device intended for the limitation of transient surge voltages and arresting of surge voltages. It contains at least one non-linear construction element. In general speech, surge protection devices are also termed arrestors.

Protection level (Up)

The protection level is the highest current voltage value on the terminals of the surge protection device before response.

Residual voltage (Vres)

The peak voltage value, occurring via the terminals of the surge protection device during or immediately after the arresting surge current has flowed.

Short-circuit resistance

The surge protection device must be able to conduct the short-circuit current, until it is either interrupted by the device itself or by an internal or external cut-off unit or by mains-side over-current protection (e.g. back-up fuse).

Response time (ta)

The response time primarily characterises the response behaviour of the individual protection elements used in arrestors. Depending on the slope du/dt of the surge voltage or di/dt of the surge current, the response times may vary within specific limits.

SPD

Surge protection device.

Surge arrestor, type 1

Arrestors, which, due to their special structure, are able to arrest lightning currents or partial lightning currents during direct strikes.

Surge arrestor, type 2

Arrestors, which are able to arrest surge voltages cause by remote or nearby strikes or switching actions.

Surge arrestor, type 3

Arrestors, used for surge protection of individual consumers or consumer groups and are employed directly on sockets.

Surge voltage

A surge voltage is a voltage occurring briefly between conductors or between a conductor and the earth, which exceeds the highest permissible operating voltage value by a long way, but does not have the operating frequency. It can be created by storms or by earthing or short-circuits.

Temperature range

The operating temperature specifies within which temperature limits the perfect function of the surge protection device is guaranteed.

Transmission frequency (fg)

The transmission frequency specifies up to which frequency the insertion damping of the employed resource is less than 3 dB.

Volume resistance per path, series resistance

The volume resistance per path specifies the ohmic resistance increase of the conductor path per wire caused by the use of the surge protection device.

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